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ART. XXIX.—*Historical and Geographical Notes on the earliest Discoveries in America;* by HENRY STEVENS of Vermont, F.S.A., etc., 4 Trafalgar Square, London.

EXPLANATORY.

IN February last the writer was asked by his brother, Mr. Simon Stevens of New York, President of the Tehuantepec Railway Company, to contribute to his forthcoming book on Tehuantepec, an Historical Introduction on the earliest discoveries in America, and on the routes of commerce of the Old World, tracing their changes, especially so far as they had any direct bearing on his project of Interoceanic Communication by way of the Isthmus of Tehuantepec. The writer accepted the opportunity, not expecting perhaps so much to aid the enterprise as to give shape and expression to certain ideas that had for years been floating and growing in his mind respecting the entanglement, in our earliest charts, of the northeast coast lines of Asia and North America, and the confusion growing out of it, in the early history, geography, and chronology of the new Continent. In reprinting that paper here, with considerable revision and emendation, necessary to harmonize it, he finds it convenient to throw the chief additional matter into an explanatory preface, rather than rewrite the whole.

Recently vast stores of material of American history have been brought to light. Old books and maps have turned up. Bibliography has become an exact science. Documents are scrutinized anew, as they never were before. New historical books have been written, old ones revived, annotated, edited and reproduced, to such an extent that half an American his-

torian's labor, before he begins his narrative, consists in clearing away the rubbish of his predecessors, and in reconciling conflicting authorities. There is something manifestly wrong in this, for the honest Muse of History is not such a muddler. Truth is not so obscured in the other coast lines of this hemisphere.

In 1793 appeared the first volume of Muños' great work. The death of the author prevented its continuation. His manuscripts and his mantle fell to Señor Navarrete, who published in 1825 his first two volumes on the voyages of Columbus, though the learned compiler had been diligently at work in official and private archives since 1789, under the patronage of the Spanish government. Then followed in quick succession, in 1828, a translation into French of Navarrete's volumes, with additions by prominent members of the Geographical Society of Paris. The same year Washington Irving gave to the world his *Life of Columbus*, built confessedly upon Navarrete's foundation. The year 1830 brought forth in London *The History of Maritime Discovery*, followed and cut to pieces the next year by Biddle's *Memoir of Sebastian Cabot*, which in turn was roughly handled in 1832 in Tytler's *Historical View of the Northern Coasts of America*. Finally in 1835–1839, after long and gigantic research, appeared Humboldt's *Examen Critique*, a digest of all that had preceded it respecting the causes that led to the discovery of the New World; the facts and dates of the voyages of Columbus, Vespucci, and others; the earliest charts, etc. This incomparable work was a masterly survey of the whole field of early American geography, and though unfinished has been the parent of innumerable minor productions. The large marine chart of the World by Juan de la Cosa, discovered by Humboldt in 1832, was here used for the first time, and was in many respects the great philosopher's grand card. More recently the labors of Kuntsmann in Munich, of Santarem and Jomard in Paris, of Ghillany in Nuremberg, of Rawdon Brown in Venice, of Bergenroth in Spain, have brought to light valuable original material illustrative of maritime discovery prior to 1492, as well as of the voyages of Columbus, Vespucci, the Cabots, Behaim, and others. Still more recently many subjects of great interest and importance pertaining to our earliest geography have been elaborated by Messrs. LaSagra, Lelewel, D'Avezac, Varnhagen, Major, Peschel, Bancroft, Helps, Parkman, B. Smith, Murphy, Lenox, Asher, Hale, Read, Deane, and not least by Brevoort, until one is ready to exclaim of the old voyagers, Are their ways past finding out? Yet there still exists the old entanglement in the American and Asiatic coast lines and the old confusion in our primitive annals and geography.

A new summing up of North American discovery has appeared in a magnum opus published in April of this year by

the Maine Historical Society, nominally the History of the Discovery of Maine, but really the history of the discovery of the whole eastern coast of North America. This learned work by John G. Kohl, LL.D. is presumed to be the culmination of all that is known and recorded on this vast subject from Adam of Bremen to Kohl of Bremen, and may therefore be held as the present state of the history of North American geography and discovery. There is appended to this volume a remarkable paper on the *four* voyages of John and Sebastian Cabot, by M. D'Avezac of Paris, in which the distinguished French geographer, on several important points, expresses views precisely opposite to those of Dr. Kohl. Both of course cannot be right, but this affords an apt illustration of the present confused condition of our geography. However, whether in all respects the Maine volume will stand the test of criticism or not, the Historical Society of Maine is deserving of high commendation for having so boldly and so honestly put forth this expensive foreign production, amply illustrated as it is with facsimiles (ut vulgo) of no less than twenty-one of the earliest maps. The whole question is now brought down to date and set up between two boards for public view and judgment. No geographer has as yet done the work better, and the only wonder is that Dr. Kohl could have done so much and so well, even from his point of view, in the short time allowed him. But—

Still the writer does not find his cravings for true and exact history satisfied. Eternal may, perhaps, and probably, are the menials of Fiction, seldom of History. Another method of treating our ancient records, he has thought, might possibly throw new light on the old geographical puzzles that have come down to us from and before the Great Discoverer, and reveal the key. The truth is that the history of the early voyages is so bemuddled by recent writers (and the newly discovered old materials seem only to add to the confusion) that nothing short of an entire overhauling of first principles, and resifting of facts, aided by rigid chronology and compound scrutiny, will enable us to take clear observations, to ascertain our bearings and show us whither we have drifted these four hundred years. The writer does not pretend that he is competent to do this himself, though he owns to the consumption of no little midnight petroleum in trying to read old records by the new light. He has attempted, after many years of bibliographical study, to step into the shoes of the old navigators, pilots and cosmographers, to see as they saw, beginning fifty years before, and coming down to half a century after Columbus, taking up the sequence of events as they occurred, and excluding rigidly all subsequent testimony. In the following paper he has given a rapid sketch of some of his observations from this point of view. A few of them are sufficiently startling if true, but require, no doubt,

further elucidation and a full declaration of authorities. These, when space is more abundant. Meanwhile the reader is invited to study well the accompanying photo-lithographic facsimiles of some of the oldest and most important maps and charts pertaining to our coasts. It is not permitted to every one to see and touch the precious originals, scattered and secluded as they are, in various public and private repositories, throughout Europe and America. Not three persons exist probably who have seen them all. The copies here given, imperfect as they are, speak clearly to the eye, and will doubtless repay careful examination, though a few explanations may aid the reader in understanding them.

And *first*, The Portolano, or marine chart of Juan de la Cosa, made by him at Puerto de Santa Maria, near Cadiz, in 1500 [Plate I]. The original, bought at a public sale in Paris about twenty years ago, for the Queen of Spain, against the writer, for 4020 francs, is now preserved in the Royal Library at Madrid. It is on oxhide, five feet nine inches long, by three feet two inches wide, cut square off at the tail, a little beyond the Ganges and Golden Chersonesus, so as to be attached to a roller; and rounded at the back of the neck, so as to be tied with a ribbon when rolled up after the manner of ancient portolani. The whole world is laid down, including the entire 360 degrees of longitude, on a given scale of fifteen Spanish leagues to a degree. The chart is well drawn, in colors and heightened with gold, altogether a work of art of considerable pretention. It is acknowledged by competent judges, to be the earliest, the most important and the most authentic geographical monument relating to the western discoveries that has come down to us. It was not discovered until after Muños, Navarrete, Irving, Biddle and Tytler had written their works, and hence Humboldt used it constantly and with effect in his *Examen Critique*, as well as in his supplemental chapter prefixed to Ghillany's Martin Behaim in 1853. A full sized facsimile was published by M. Jomard, on three double elephant folio sheets, some fifteen years ago. Of the western sheet, or third, not colored, the accompanying reduced facsimile is taken. La Sagra, Lelewel, Ghillany, Kohl and others have used it extensively and described it. All geographers admit its importance, but many raise objections greatly diminishing its authority. These objections have hitherto been deemed unanswerable. They are: *First*, That Cuba is represented as an island in the year 1500, and is misshaped at the western extremity by curving to the south so as to form a kind of gulf, when in fact it was not ascertained to be an island till Ocampo circumnavigated it in 1508, and found it to extend considerably farther to the west than La Cosa's, and having no such curve. *Second*, that the American coast line extending from a point west of Cuba to the *Mar descubierta por Yngleses* gives no proper idea of the Gulf of Mexico, Florida,

New York, Cape Cod and other strongly marked coasts, in fact is mere guess work. *Third*, that the discoveries of the Cabots and Cortereals are not properly laid down, and that the coast line does not resemble that from Cape Race westward. And *fourth*, that "the map has no indication of the degrees of latitude" (Kohl, p. 152) and longitude.

These four objections answered, Juan de la Cosa is vindicated, and his chart becomes *the* authority. Let us look at them. Answer, *First*, that La Cosa, the *Maestro de hacer cartas*, as Columbus styled his chart-maker, did not intend to represent Cuba to be an island (whatever posterity may think of his drawing) is manifest from the following facts. In the spring of 1494 after Columbus, in his second voyage, had sent home from Hispaniola (his Zipangu or Japan) the larger part of his fleet under Antonio de Torres, he resolved with three caravels and about eighty men, to go on an exploring expedition along the south side of Cuba (which he for sometime persisted in naming Juana) supposing it to be continental, or that part of Asia near Mangi. This little fleet reached Cuba on the last day of April at a point named Cabo de Fundabril, first called by Columbus Cape Alpha and Omega, the point where the West ends and the East begins. Proceeding westward they touched at many places, the names of most of which, laid down by La Cosa, can readily be recognized in the narratives of the Cura de los Palacios and Peter Martyr, as well as in later maps. These names are Cabo de Cruz, Cabo del Serpienta, Fumos, Cabo Serafin, Mangni, Mont, Bienbaso, &c. At length they came to a turn in the coast to the southwest. This place Columbus named Cabo de Bienespera, or Cape of Good Hope, a guiding point leading him on toward the Golden Chersonesus, the bourne of his hopes. Here on the 12th of June, 1494, Columbus, being compelled to turn back from shortness of provisions, caused his captains, his pilots, his master of charts, and all his sailors to sign a declaration under oath, that they believed Cuba to be part of the Continent of Asia, near Mangi; and Juan de la Cosa added the further particulars that he never saw and never heard tell of any island 335 leagues long, and hence he believed Cuba to be in Asia. A little further on to the south-southwest, amid shoals and islands, picking his way and grazing the sands, Columbus reached another place which he named Evangelista. Here, from the mast head, one might see coasts to the north, the Bay of Cortes and the Cayos de Indios to the west, and land to the southwest and south, the whole, with islands and keys, appearing continuous so as to form a gulf of considerable extent studded with islets. This body of water Columbus mistook for the Gulf of Ganges! "Indiæ Gangetidis continentem eam esse plagam contendit Colonus," wrote Peter Martyr to Cardinal Bernardino, August, 1495, on the authority of

a letter to him from Columbus himself. This place was the farthest point touched in the expedition, "hanc ultimam existemati continentis oram quam ille [Columbus] attigit, vocavit Evangelistam," again wrote P. Martyr. The Admiral longed to go on down the coast, double the Golden Chersonesus, visit Calicut and Arabia, and so return to Spain, ever going west, but necessity compelled him, the next day, to set his face toward Hispaniola. Here then is the key of this mystery, the parent of a hundred geographical blunders, in later maps. Evangelista is on the west side of the Isle of Pines, the Cape of Good Hope is on Cuba to the N.N.E. near Batabano, and a dash of *green* paint, the conventional color for *terra incognita* in old portolani, marks a "cut-off" and completes the Gulf of Ganges! This simple cut-off shows that all beyond was unknown. Three days more, had Columbus persevered toward the west, would have brought him to the end of Cuba, and dispelled all his grand visions of the Province of Mangi, and the incomparable riches of the Grand Kahn of Cathay. Cuba is then here not an island, but is merely cut off in the usual way by La Cosa himself who was there with the Admiral, and who laid down the track of the whole expedition with marvellous truthfulness.*

The answer to the *second* objection, as to the *American* coast

* Ruysch, seven years later (Pl. 2, No. 3) understood this perfectly, and in his Continental Cuba marked this cut-off more distinctly. He has preserved the "Gulf of Ganges," but has disguised some of the names of places. Cape Seraphin where the white priest was seen, is changed to Cvlcar [c. vicar?] and Evangelista to C. S. Marci, one of the Evangelists. The south side of Cuba is a literal copy of La Cosa's chart laid down from actual survey in company with Columbus himself, but the north side considered as part of Asia beyond Zipangu, is carried up to about 40° N. latitude, above C. Elicontii the same as in Fra Mauro's map of 1457 and Behaim's globe of 1492. The German geographers of St. Dié and Strasburg, (who probably never saw salt water) in their map in the Ptolemy of 1513, probably made as early as 1508, (Pl. 2, No. 1) have copied La Cosa and Ruysch both, making Spaniola and Isabella answer for the Japanese islands, all the names being transferred to their Continental Cuba with most of the names of La Cosa and Ruysch Italianized, and almost obscured in the transfer. Corveo, Anterlinoi, Cvlcar and Lago de Loro of Ruysch become Coruello, G. delinor, C. lurcar, and lago dellodro in the 1513, while C. Elicontii becomes C. delicontir. La Cosa's Mar Oceanus, north of Cuba, becomes C. del mar usiano and is carried up to latitude 54°. The Gulf of Ganges is not only preserved, with all the islands of La Cosa, but the three mouthed Ganges itself is made to empty into the gulf! All this *Terra de Cuba* was thought somehow, to pertain to Asia, for no one yet had dreamed of an intervening continent. The north side of Cuba in La Cosa's chart, west of Rio Mares (the farthest point reached by Columbus in his first voyage, the 31st of October, 1492,) is colored as *terra incognita* having no defined coast line. The very accurate manner in which the whole coast eastward of this point is laid down renders it almost certain that La Cosa accompanied Columbus also in his first voyage as his Maestro de Cartas. If so, considering his subordinate position, may not this be in substance the long lost chart of Columbus? The names written in full are rio Mares, rio Luna, Cabo de Cuba, punta de Mar Nuestra Señora, punta de Santa Maria, Cabo Rico, Puerto Santo, rio de la Vega, Cabolindo and ponta de Cuba, corresponding almost exactly with the log book or journal of Columbus as preserved by Las Casas. It should, however, be mentioned that Senhor Varnhagen, in his valuable work on Vespucci, printed in Lima, in 1865, differs from the writer, interpreting these to be the Mississippi River, the Gulf of Mexico and Florida.

line from the west of Cuba to Bacalaos is simply that La Cosa intended that line for Asia. In 1500 neither he nor anybody else suspected or dreamed of an intervening Continent. La Cosa projected a map of the whole world, the Eastern Asia of Marco Polo and Sir John Mandeville included. Cutting his map off at the Golden Chersonesus, beyond the Ganges, so as to attach it to a roller, how else could he complete Asia and the 360 degress of longitude but by the line he drew on the other side of the globe? Asia and America are not *both* laid down. Which is omitted? If this line be the unknown new Continent, what has he done with the well known part of the old Continent? Furthermore, where are Zipangu and the islands of the Eastern Archipelago described by Marco Polo and so ardently sought by Columbus? If Cuba be Zaiton or Mangi, surely Hispaniola must be Zipangu [Pl. 2, No. 3]. How else could Columbus reason? Let it be borne in mind that there is great similarity in the coasts of Eastern Asia and America. From all this it is apparent that La Cosa and his map are not responsible for erroneous conclusions drawn by modern geographers.

The *third* objection, respecting the coast line of the Cabots and the Cortereals, from Cape Race westward, may be met by the fact that La Cosa has laid down no such line. Cape Race is in latitude 46° 40′, and Cape Sable in Nova Scotia, is 43° 24′. La Cosa's coast line in the north, marked by five English flags, begins at latitude 53° N., that is the Straits of Belle Isle, and extends very nearly west to the meridian of the Virgin Islands. It is, in short, the northern coast of the Gulf of St. Lawrence, pretty accurately depicted. Of course it is to be understood that the Cabots in 1497, as well as La Cosa in 1500, supposed this coast to be in Eastern Asia. This chart carefully compared with Sebastian Cabot's map of 1544 [Pl. 4, No. 1,] and studied with the new material lately brought to light by Mr. Rawdon Brown in Venice, and Mr. Bergenroth in Madrid, will, it is believed, harmonize well, as contemporary documents, and throw into the shade the loose gossip, long after date, reported by Butrigarius and Peter Martyr. The words *Mar descubierta por Yngleses*, instead of *Mar Oceanus*, show it to be a sea or gulf and not the open ocean. If the reader will lay down on La Cosa's chart Newfoundland, Cape Briton Island, Nova Scotia and New Brunswick in their proper latitudes and longitudes, he will doubtless be surprised at the result, especially when he compares it with the map of F. G. in Hakluyt's Peter Martyr of 1587 [Pl. 3, No. 1]. The discoveries of the Cortereals could not have been known by La Cosa in 1500.

The *fourth* objection is answered by simply looking for a moment at the original map, or at M. Jomard's facsimile, and not at the imperfect ones generally in use. The indications of latitude and longitude are abundant, and there is a good scale both

at the top and the bottom of the chart. The equator is given, and the tropic of Cancer, 23½°, and guiding lines or parallels pass through the Straits of Gibralter 36°, and Paris 48° 40′. These fixed points, with the scale, will help the reader to the latitude of any other place. Longitude can be determined in a similar way.

The eclipse that took place in Sept., 1494, immediately after his return to Hispaniola from Cuba, was a most important event for Columbus, because it enabled him to determine the longitude of his discoveries. He found that the middle of Hispaniola was nearly five hours west of Seville, or about 70°. La Cosa's scale marks this distance to be about 68°, sufficiently near, considering the mode of measuring time then, before Copernicus had commanded the sun to stand still. Columbus' mistakes in latitude are difficult to be accounted for, but they do not affect the observations of the Cabots in the north, or those of Vespucci and Ojeda in the south, as laid down by La Cosa.

Now if these objections are fairly answered, La Cosa not only emerges cleared from a vast amount of unjust criticism, but his chart becomes a beacon of light in the early annals of America. It tells posterity, as it is told nowhere else so truthfully, of Columbus, his discoveries and his mistakes, and depicts in honest lines just how far the Great Explorer groped his way blindfolded toward the west. The American historian has no longer any difficulty in tracing the track of Columbus to the very end, and accounting for the true and the false lines in his continental or Asiatic Cuba. He sees how the Asiatic lines grew in the map of Ruysch of 1508, while those of La Cosa remained the same; how also in the maps of Bernard Sylvanus in 1511, of the Gymnasium of St. Dié in 1513, of the Margarita Philosophica in 1515, of Apian and Schoner in 1520, of Bordone in 1521, of Lawrence Fries in 1522, of Orontius Fine in 1531, and of Sebastian Muenster in the Grynaeus of 1532. In all these old maps the geographer can at a glance, now that the key is recovered, trace the true coast lines, for he knows the origin of the false ones, thanks to painstaking La Cosa. Considering the state of grographical, astronomical, and nautical knowledge at that time, and the muddle of the map-makers, it is not to be wondered at that the discoveries of Balboa, of Magellan, of Cortes, of Ponce de Leon and Ayllon, led to some bewilderment, and puzzled even the *cognoscenti* of the Congress of Badajos. Before 1520 the Portuguese began to comprehend better the longitude of the Moluccas and other of their possessions in the East, and geographers began to suspect an intervening space not accounted for. At first strange guesses were recorded as to the extent and direction of the South Sea, by Schoner and others, but after the appearance of the map of Cortes [Pl. 4 No. 7] in 1524, the culmination of absurdity appeared in the elaborate double-hearted projection of Orontius Fine in July, 1531 [Plate 3, No. 3 and 4]. Schoner in describing his own newly improved globe in 1532, exactly describes this map. The South Sea was represented as south of the equator, while Asia was brought forward to Bacalaos. One can readily see how all this grew up, as one can also see how, by slow degrees, their false Asia receded and melted away, for above 200 years, as the western coast of America and the eastern coast of Asia were explored by Spanish, English, French and Russian navigators, till the year 1727, when a strait was opened by Behring, and Asia and America became divorced.

It was the writer's intention to try and trace out the history of the first exploration of the entire coast of the United States, until the last thread of the Asiatic line was expunged by Capt. John Smith before 1614. But that labor, even if he had time and space, is reserved for an abler pen. The Rev. Dr. Leonard Woods, late President of Bowdoin College, has on the anvil as already announced, for the Maine Historical Society's next volume, an original unpublished manuscript of Richard Hakluyt, of the highest historical and geographical interest. It is entitled "A particular discourse concerning the greate necessitie and manifold comodyties that are like to grow to this Realme of Englande by the westerne discoveries lately attempted, written in the yere 1584, by Richarde Hackluyt . . . at the requeste of Mr. Walter Ralcigh before the comynge home of his two Barkes [from Virginia]" &c. This invaluable manuscript, consisting of sixty-three large closely written folio pages, was in the possession of the writer for two or three years, having fallen into his hands some sixteen or seventeen years ago by a piece of good luck, after a bibliographical tournament memorable as any recorded by Dibdin. After fruitless

endeavors to find for it a resting place in some public or private library in America, and subsequently in the British Museum, it finally became the property of Sir Thomas Phillipps. So impressed was the writer with its importance that immediately on learning the object of Dr. Woods' mission to England in the autumn of 1867, he called the Doctor's attention to it, and suggested his procuring a copy, if possible, for publication by the Maine Historical Society. He trusts soon to have the pleasure of seeing Richard Hakluyt again in print, not alone because he is an old friend, but because he is likely to render any further discussion of the present subject, on the part of the writer, superfluous.

Historical and Geographical Notes, 1453—1530; by HENRY STEVENS, of Vermont, F.S.A., etc., Trafalgar Square, London.

A retrospect of four centuries, with a rapid glance at the progress of modern discovery, exploration and invention, will probably serve as an appropriate introduction to our projected scheme of Interoceanic Communication by means of the Tehuantepec Railway, and show that the time is near at hand for its accomplishment. Let us, therefore, go back for a moment, and survey the little old world and its inhabitants as they appeared about the middle of the fifteenth century. According to Ptolemy, the best recognized authority, whose geography had stood the test of thirteen hundred years, the then known world was a strip of some seventy degrees wide, mostly north of the equator, with Cadiz on the west, and farthest India or Cathay on the east, lying between the frozen and burning zones, both impassable by man. The inhabitants, as far as known in Europe, were Christians and Mohamedans, the one sect about half the age of the other. Christendom, the elder, that once held considerable portions of Asia and Africa, had been driven back inch by inch, in spite of the Crusades, even from the Holy Land, the place of its birth, up into the northwest corner of Europe; and both in lands and people was outnumbered six to one by the followers of Mahomet. For seven hundred years the fairest provinces of Spain acknowledged the sway of the Moors, and the Mediterranean, from Jaffa to the Gates of Hercules, was under their control. The crescent was constantly encroaching on the cross; while Christendom, schismatic, dismayed, demoralized and disheartened, seemed almost incapable of further resistance.

India beyond the Ganges, from the days of Moses, Alexander, and Aristotle, to say nothing of the geographers Pomponius Mela, Strabo and Ptolemy, was deemed the land of promise, the abode of luxury, the source of wealth, and the home of the spices; but the routes of commerce thither, via Venice and Genoa, by the Red Sea, Egypt, the Nile, Arabia, Asia Minor, the Black and Caspian Seas, through Persia and Tartary, were one by one being closed to Christians. The profits of the overland carrying trade were mostly in the hands of the Arabians, who inherited it from the Romans; but Memphis, Thebes, and Cairo, that flourished by it, had declined as it fell off, and yielded

to Alexandria nearer the sea. Finally, in 1453, Constantinople, the Christian city of Constantine, fell into the hands of the Turks, and with it the commerce of the Black Sea and the Bosphorus, the last of the old trading routes from the East to the West. Christendom for a time was disconsolate, and could only "pray for the conterition of the Turks." The whole of the carrying trade passed into the hands of middle men or agents, who passed goods without news, and India became more a land of mystery than ever; but this apparent misfortune proved to be the beginning of a new and brighter era.

The learned Christians of Constantinople, with nothing but their heads and their books, fled in exile into Italy, and became its schoolmasters. At once began there the revival of learning, which soon extended throughout the West. "Westward the course of empire takes its way." The Medici family of Italy, at Venice and Florence, welcomed these learned Greeks, and bought their precious manuscripts of ancient lore. The gunpowder of Europe had already silenced the Greek Fire of Asia. On the Rhine the young printing press was just giving forth its first sheets. The compass and the astrolabe, recent inventions, began now to give confidence to mariners and teach them that, though the old paths of trade overland were closed, they might venture on new ones over sea. In 1453, in western Europe there was no tea, no coffee, no tobacco, no Indian corn, no potatoes; and many of the necessities of our day were not even known as luxuries. Though the Crusades had failed in their immediate objects, they had exposed the secrets of the India trade, and the vast revenues of the eastern cities. The manuscript travels of Marco Polo and Sir John Mandeville had found their way into the hands of thinking men. Venice was already waning, preparatory to yielding its trade to Portugal, the then most rising and active maritime power. Prince Henry the Navigator had still ten years to live to carry out his great schemes of discovery and exploration of the western coast of Africa. He was an ambitious student of geography, history, mathematics, astronomy, and navigation, and for almost forty years had stood alone. At the early age of fifteen he had a successful brush with the Moors at Ceuta, opposite Gibraltar; and by 1418 had crept down the coast of Africa to Cape Nun, lat. 28° 40′, the southern boundary of Morocco. In 1434 his captains doubled Cape Boyador, and seven years after obtained from Pope Martin V. a grant to the crown of Portugal of all he should discover from this cape to the Indies. In 1442 Rio del Oro was reached, and gold and negro slaves brought back. These were two real stimulants to Portuguese discovery, avarice, pride, and wealth, though the conversion of the infidels to Christianity, was, no doubt, a strong additional motive power. The reintroduction of negro slavery, and the part it soon played in com-

merce and the world's progress, may be ascribed to Prince Henry. He encouraged the traffic, which, with the love of gold and the hatred of the Moors, aroused his countrymen to his projects, and insured the promotion of discovery, in so much that by the time of the fall of Constantinople, his captains had reached Cape Verde, lat. 14° 45′ N., probably a few degrees beyond, and had exploded the old theory of a boiling belt about the equator.

In all ages there had been a prevailing notion that one might sail round Africa; but when once it was demonstrated that Portuguese sailors could cross the equator and survive, Prince Henry's vague idea of reaching the land of spices by this route was confirmed. At all events, he was schooling hardy sailors, and training them for bolder work, so that soon after the date of the fall of Constantinople, Italy and Portugal had reached that turn for adventure and enterprise, which spread like wildfire throughout the other states of Europe, and caused the entire revolution in the commerce of the world.

In 1453, Columbus was a lad of six years at Genoa, Vespucci of two at Florence and John Cabot a youth at Venice. The new learning at once took deep root. When these three Italian boys became men, behold how changed! The sciences of mathematics, astronomy, and navigation had grown with their growth, and developed with marvelous rapidity. The press had spread broadcast the learning of the ancients. The secrets of the earth were inquired into and revealed. Many islands of the Atlantic had been discovered and described, and sailors knew the coasts of Europe and Africa from Iceland to Cape Verde. But above all, the knowledge of the sphericity of our earth was no longer confined to philosophers. Alexander had told Aristotle what he knew of the East, and Aristotle had written down that there was but a small space of sea between Spain and the eastern coast of Asia. Strabo had said that nothing stood in the way of a westerly passage from Spain to India but the great breadth of the Atlantic Ocean; but Seneca said this sea might be passed in a few days with favorable winds. Pomponius Mela and Macrobius put in like testimony, with certain difficulties about passing burning zones, and the earth being shaped like an egg floating in water. All these opinions were rehashed and digested by Ptolemy of Alexandria, in the second century, who first properly reduced the globe into 360 degrees of latitude and longitude. In latitude he was as correct as he was incorrect in his longitude. Roger Bacon, an Englishman, again summarized these theories in his *Opus Majus*, in the thirteenth century; and in the fifteenth century, Pierre d'Ailly, a Frenchman, reviewed the whole question, bringing together the opinions of the ancient writers named, as well as the fathers of the church, including modern philosophers, travelers, and theologians, es-

pecially Roger Bacon, Marco Polo, and Gerson, and gave to the world his well-known *Imago Mundi*. This celebrated work, finished in 1410, was afterward the guide, companion and friend of Columbus. The learned author was for three years Provost of the ancient Ecclesiastical College of St. Dié in Lorraine, away up in the Vosges Mountains, in the remotest corner of France. This was on the very spot where, nearly a century later, in the Gymnasium within the same precincts, a confraternity of some half dozen earnest students, lovers of geography, of whom the poet Mathias Ringman was the soul, in a little work called *Cosmographiæ Introductio*, printed there in the kalends of May, 1507, suggested that the *Mundus Novus* of Vespucci should be named America, after a man, inasmuch as Europe and Asia had been named after women. Thus a little mountain town of France first gave aid and comfort to Columbus and afterwards a name to the New World.

As early as 1474, Paul Toscanelli, a learned physician of Florence, sent to Columbus a Chart made after the narrative of Marco Polo, and was in correspondence with him on these very subjects, showing that even then the plans of Columbus were maturing. In 1478, the great geographical work of Ptolemy, with the twenty-seven beautiful copper plate maps, was printed at Rome, and about the same time many other of the ancient historians, poets, philosophers, mathematicians, and astronomers saw the light. The *Imago Mundi* was printed at Louvain, in 1483, and there still exists at Seville, Columbus' own copy, with manuscript notes said to be his, discovered and described about forty years ago by our countryman, Washington Irving.

Meanwhile, the work of discovery and exploration was earnestly pursued by the Portuguese. In 1454 Prince Henry secured the services of Cadamosto, an intelligent Venetian, well acquainted with the trade of the Mediterranean and the East, and sent him down the coast of Africa, where he reduced the explorations and the trade to order, and pushed southward the discoveries to the Cape Verde Islands by 1460, the year of Henry's death. By 1462 Pedro de Cintra had crept down the coast to some 300 miles beyond Sierra Leone. In 1463 Gibraltar was captured by Spain from the Moors. Kings Alphonso and John continued the African discoveries with so much energy that, after Diogo Cam's passing Congo in 1484, the bold captain, Bartholomew Dias, reached the Cape of Good Hope, and looked beyond it in 1487, thus completing with marvelous perseverance an exploration of some six thousand miles of coast line in seventy years. Bartholomew Columbus was in this last expedition.

Meanwhile King John had sent overland through Egypt Pedro de Covilham, to India and Eastern Africa to gain information and report. In 1487 he reported that he had visited Ormuz, Goa, Calicut, etc., and had seen pepper and ginger, and heard

of cloves and cinnamon. He visited the eastern coast of Africa, went down as far as Sofala, and returning northward, sent a message to King John that he had learned for certain that if Dias should pursue his course round Africa he would reach India over the Eastern Ocean via Sofala. This theoretical discovery of Covilham exactly coincided with the practical one of Dias.

All these events were but leading up to the grandest discovery the world ever knew, but it is difficult to trace the precise origin and the gradual development of the plans of Columbus. We know, however, that at the early age of fourteen he went to sea, educated with small knowledge of Latin and less Greek; and in 1474, at the age of twenty-seven, was in correspondence with Toscanelli, and became the father of Diego, the boy for whom, some ten years later, he begged a night's lodging at the Convent of La Rabida. By the year 1487, when the mystery of a path to India around Africa was solved, he had not only completely worked out his great idea of sailing West to find the East; but had offered his services in carrying it out, first to his native city, Genoa, without success, and had two years before brought it to Spain from Portugal where his proposals had been openly spurned and ridiculed, but treacherously though unsuccessfully tested. It is tolerably certain that much of his time had been spent in active and practical maritime service, for he had been down the coast of Africa as far as El Mina; had resided at Porto Santo, one of the out-lying Portuguese islands of the Atlantic, the daughter of whose first governor had become his wife; had visited England and Iceland, and was acquainted with the whole of the Mediterranean. His brother Bartholemew had been a chart-maker at Lisbon, and was his advocate at the court of Henry VII.

We know from the writings of his son Ferdinand that Columbus was both a practical and a learned mathematican as well as navigator. He had read probably all the compilations named above, and his own experience, together with what he had learned from the Portuguese, had enabled him, with his Marco Polo in his pocket, to sift all the vague and contradictory notions of the ancients as to the Antipodes and the shape of our earth, as well as to cypher out a theory of his own. For seven long years, after being worn out and disgusted elsewhere, he danced attendance on the Spanish court, with no fortune but his idea; sometimes threadbare and barefooted, ever pressing his suit, never flagging in his confidence, questioned and ridiculed by commissions of geographers and scientific men, without ever being able to penetrate the conservative ignorance of the learned and courtly, or, as he complained, to convince any one man how it was possible to sail west to reach the East. But Time was working for him then, as it is now for Interoceanic Communication.

The fortieth year from the fall of Constantinople, the forty-fifth of the age of Columbus, witnessed the death of Lorenzo de Medici; but other suns were rising. Copernicus, in the far north, was in his twentieth year; Erasmus, his twenty-fifth; Cortez, his seventh; and Luther, his tenth. Martin Behaim, the old geographer of the Azores, aged sixty-two, was home on a visit to his native city of Nuremberg, from which the tide of commerce was ebbing. Here, in 1492, he made his famous globe of the whole world, as if to lay down upon it all the knowledge (and all the ignorance) of the geography of the earth, preparatory to the opening of new books. The same eventful year witnessed the expulsion of the Moors from Spain, the opening of the Mediterranean, and the discovery of America. Mohamedanism received its first check, and Christendom received a New World. These three Italian boys had become men. When Columbus had balanced his egg for Spain, it was easy for Vespucci and the Cabots to do it for Portugal and England. Italy, whose noble sons did this in foreign service, never acquired a foot of the newly discovered lands for herself, yet how much of the honor was and still is hers.

In 1493, within three months from the return of Columbus, Alexander VI, a Spaniard, a Pope of not a year's standing, wishing to reward Ferdinand and Isabella, for their struggles in expelling the Moors, divided our globe into two parts, by a line of demarcation passing from pole to pole, one hundred leagues west of the Azores and Cape Verde islands, giving to Spain all she should discover within 180° to the west of it, leaving to Portugal all her African discoveries and the Indies for 180° east of it. But poor Portugal, that had been struggling seventy years in the dark in her circuitous route to India round Africa, jealous of the new short cut of Columbus, which had been offered to her and refused, protested against the position of this meridian. It was finally settled in the treaty of Tordesillas, of June, 1494, with the Pope's approval, that the line should stand at three hundred and seventy leagues west of the Azores. Had the King of Portugal's geographers and pilots advised him to contend for a line farther east instead of farther west, he would have received within his half the Moluccas and the other Spiceries. As some compensation for this geographical blunder, however, he secured a foothold in Brazil. Both nations were now running a race of discovery of India by divers routes. By India is here meant all the East beyond the Ganges, including China, Cathay, Mangi, Japan, and the Spice Islands. The acquisitions of the Spaniards were named the West Indies, while those of the Portugese were called the East Indies.

Never was great discovery more modestly announced. "*A Letter of Christopher Columbus, to whom our age is much indebted,*

respecting the Islands of India beyond the Ganges lately discovered," dated February, 1493. Columbus thought his success complete. He aimed at Zipangu, or Japan, and to his dying day in 1506, believed that he had found it nearly where his calculations had placed it, but never was man more mistaken, and never did mistake produce greater results. Believing our earth to be a globe, Columbus reasoned correctly that by sailing west he would come to the East of Marco Polo, but from want of knowledge of longitude, he, like everybody else, from Ptolemy down, was vastly deceived as to the size of the globe. From Cadiz to the Ganges the distance had been computed from the days of Alexander at about 180°, or half round the globe. From the Ganges to the Corea and Cathay, and thence to Zipangu fifteen hundred miles more, the distance was also exaggerated by Marco Polo. So that, still going east, the distance from Zipangu to Cadiz was calculated to be about equal to the space from Palos to Saint Domingo. Upon this error in longitude hung no doubt the problem of circumnavigating the globe, for had Columbus suspected the real distance to Japan by the west, he would never probably have ventured to penetrate the "sea of darkness," or have found sailors bold enough to accompany him. The actual distance from San Francisco to Hong Kong is nearly one-third more than Columbus had reckoned it from Spain to Japan.

The sensation produced throughout Europe by this discovery of a short and direct route to India was great, but for nearly forty years nobody suspected the truth. The simple letter of Columbus in various editions, in prose and verse, was about all that was published for ten years, but the intelligence gave a new impulse to maritime discovery and commercial enterprise. Columbus, with full honors, sailed in 1493, with a well equipped fleet to explore his Eastern Archipelago. He returned to Spain in June, 1496. Juan de la Cosa, author of the world-renowned portolano of 1500, went with him as Master of Charts in this second voyage. They proceeded directly to Dominica, one of the Windward Islands, thence to Porto Rico, St. Domingo, south side of Cuba, Jamaica, &c.

The Portuguese now redoubled their energies, and in 1497–98, Vasco da Gama, just ten years after Dias' discovery of the Cape, circumnavigated Africa and reached Calicut. The same year John Cabot under a Patent of Henry VII, dated March 5, 1496, in trying for a short cut to Cathay by the northwest, discovered certain islands, probably in the Gulf of St. Lawrence, and took possession, supposing them to be off China, and erected conjointly the flags of England and Venice, on the 24th of June, 1497. The next year Sebastian Cabot, under a supplemental license dated Feb. 3, 1498, sailed again with the view

of planting a colony and promoting trade, but no contemporary account of the voyage being known, it is difficult to extract any reliable information of this failure from the confused gossiping reports that have come down to us. The discoveries of 1497 were in 1498 reported to the kings of Spain by their vigilant ambassador in London, with the intimation that he had seen John Cabot's chart, and would send home a copy of it. What steps followed it is difficult now to trace, but the result appears to be that Henry VII, never following up the discoveries after 1498, Sebastain Cabot remained quietly at home till after the death of Henry, when in 1512 he took service under the king of Spain, permitting his English and Venetian rights of discovery and plantation to lapse. Thus ended the first English and Venetian attempts to reach Cathay by the northwest.

On the 30th of May, 1498, in his third voyage, Columbus first touched the continent of America in Venezuela, though some contend that Vespucci had anticipated him by nearly one year. The natives called it Paria, and Columbus reasoned himself into the belief that it was Paradise, whence our first parents had been driven. In 1499, Vicente Yañez Pinzon and Alonzo de Ojeda, private traders, with the latter of whom was Vespucci on his second voyage, visited Brazil under Spanish flags; and in 1500 Brazil was discovered accidentally (?) by Cabral, in that great fleet which the success of Gama had called forth. He was blown out of his course on his way to India, and took possession for the Portuguese. Portugal thus gained undisputed possession of Eastern Brazil by rule of ignorance of longitude, claiming it as hers because it was east of the line of demarcation. All the science of Spain at that time could not disprove this, and therefore Pinzon abandoned it to the Portuguese. The same year the Portuguese hearing of the voyages of the Cabots, and probably suspecting irreverence in the English for Papal bull lines of demarcation, sent Gaspar Cortereal to follow in their track, who returned in the fall of 1500. Between May 15 and the 8th of October, 1501, a second voyage with two ships was made by Gaspar Cortereal, and laborers (slaves) brought back to Lisbon, but Gaspar himself never returned. A third voyage was undertaken by Miguel Cortereal from Lisbon to the northwest the 10th of May, 1502, in search of his brother, but no tidings ever came back. Then the king dispatched two more vessels to cruise in search of the missing ones, but they returned without any trace of the lost brothers, and thus ended the Portuguese attempts to reach Cathay by the northwest.

In 1501 New Granada, Darien, and Panama were taken possession of for the Spanish by Bastides, and in 1501–2 Vespucci explored the coast of Brazil for the Portuguese, it is said, as far as 50° S. lat., within two or three degrees of the strait, and in

1502 there was written an account of his expedition, which was soon after printed, under the title of *Mundus Novus*. The years 1502 to 1504 were occupied by Columbus in his fourth and last voyage, in which he was accompanied by his brother Bartholomew, and his son Ferdinando who afterwards wrote a life of his father. He explored the coasts of Central America from Truxillo in Honduras to Darien, still looking for the Ganges and inquiring for the home of the Grand Kahn. An account of this voyage, coming down to July 7, 1503, was printed at Venice in 1505.

In 1502 Valentim Fernandez, a German, attached to the household of the ex-queen of Portugal, edited and printed at Lisbon a collection of voyages in the Portuguese language, comprising Marco Polo, Nicolo Conti, Santo Stephano, &c., with a view of stirring up the people to a more lively interest in the commerce and navigation of the Indies. The success of Columbus and the Cabots is referred to, and the speedy return of Cortereal from the north, from his second voyage, is expected. This magnificent folio volume, the first important book (not biblical) printed in Portugal, must have had a powerful effect in drawing popular attention to the land of spices. It was the first collection of voyages printed in the vernacular tongue, and could be read by all the unlearned who had a penny to venture. It was translated into Spanish, and printed at Seville in 1503. No rarer books are now known to geographers. In May, 1507, the four voyages of Vespucci were published for the first time together, in Latin, at St. Dié, in France, as before stated, as an appendage to a little work on cosmography, a science which now began to assume new and startling importance.

On the third of November, the same year, there was published in Italian, at Vicenza, a most important collection of voyages under the title, *Countries newly discovered, and the New World of Albericus Vespucci*, containing accounts of the voyages of Cadamosto to Cape Verde, in 1454–5; of de Cintra to Senegal, in 1462; of Vasco da Gama, in 1497–1500; of Cabral, in 1500–1; of Columbus (three voyages) 1492–1498; of Alonzo Negro and the Pinzons; of Vespucci (four voyages); of Cortereal, &c. This work was the next year, 1508, printed in Latin and German.

All these new geographical works hitherto printed, it will be perceived, pointed to the same thing, enlightenment of the public as to India beyond the Ganges, and how to go and trade thither. In 1508, for the first time in print, all these discoveries were collected and laid down in a beautiful copper-plate map, by Johann Ruysch, a German who had probably* visited

* Beneventanus says "Joannes vero Ruisch Germanus Geographorum meo judicio peritissimus, ac in pingendo orbe diligentissmus cujus adminiculo in hac lucubratiuncula usi sumus, dixit, se navigasse ab Albionis australi parte; et tamdiu

the new found islands with the Cabots, and knew well what he was doing. It appears in the Ptolemy of 1508, published at Rome, accompanied by *A new Description of the World, and the new Navigation of the Ocean from Lisbon to India, by Marcus Beneventanus.* A careful study of this map and its descriptive text, if we exclude all subsequent publications, and look at the world as seen by the geographers of that day, will greatly aid us in clearing up many apparent inconsistencies.

Ruysch lays down three distinct and independent fields of discovery. First, the Archipelago of Columbus in the center, filling a space of above a thousand miles from north to south, and open to India. This part of the map was no doubt laid down from Columbus' own letter, the only authority, in 1507, existing in print. He had, indeed, coasted along Paria from Trinidad westward, in June, 1498, as Pinzon, Ojeda, and others did subsequently, supposing it to be another large island, or part of the mainland of Cathay, but nothing of this had then been printed. Second, the *Mundus Novus* of Vespucci, being the eastern coast of South America from Darien to Upper Patagonia, one vast Island with an unknown background. The authority for this was what has since been called Vespucci's "Third Letter," first printed at the end of 1502, or probably early in 1503. And third, the discoveries of the Cabots and the Cortereals in the north, represented by them as part of the mainland of Asia. This portion of the map is only Marco Polo's description of Cathay extended considerably to the northeast, and modified by the experience, probably, of Ruysch himself, and the information he gathered from the Bristol men, when he was with them in 1497–8 and the discoveries of the Cortereals.*

quo ad subparallelum ab subæquatore ad boream subgradum, 53, pervenit; et in eo parallelo navigasse ad ortus littora per angulum noctis atque plures insulas lustrasse, quarum inferius descriptionem assignabimus." *Anglicé:* But John Ruysch, of Germany, in my judgment a most exact geographer, and a most painstaking one in delineating the globe, to whose aid in this little work I am indebted, has told me that he sailed from the south of England, and penetrated as far as the 53d degree of north latitude [straits of Belle Isle], and on that parallel he sailed west toward the shores of the East [Asia], bearing a little northward [*per anglum noctis*] and observed many islands, the description of which I have given below.

* The chart of Juan de la Cosa, representing the then known world bearing the date of 1500, is not overlooked, but its significance, so far as the coast line of the United States is concerned, has been so manifestly distorted by every one who has described it, from its discovery by Humboldt in the library of Baron Walckenaer, nearly forty years ago, down to the present day, that the writer hesitates to venture his opinion. But by long study and comparison of this with other early maps, especially with those of Ruysch and Peter Martyr of 1508 and 1511, he is convinced that the coast line, from the most westerly of the five English flag-staffs marking the extent of Cabot's discoveries southward and westward, to a point west of Cuba, precisely like the map of Ruysch seven or eight years later, is laid down as the northeastern coast of Cathay, from the descriptions of Marco Polo. If our Maine friends, therefore, will place behind their red line border, Marco Polo's name *Mangi*, they will see that this territory is farther "down East" than is generally supposed.

Columbus had placed his discoveries in the Indian Archipelago beyond the Ganges, and the world accepted the names he gave to the separate islands. No new general name was required. The discoveries of the Cabots and the Cortereals being also in

being indeed eastern Asia. The word Cuba, instead of *Juana*, the name given by Columbus, and the fact that it is represented as an island have been strenuously objected to by geographers, but both these objections will be answered in another place. [See preliminary preface.]

La Cosa perished in Ojeda's mad expedition in Dec., 1509. He was a clever fellow, and a great favorite, and used to boast that he knew more of the geography of the new lands than did Columbus himself. Indeed, of all others, says Peter Martyr in 1514, his charts were the most esteemed. His knowledge and experience were great, for he had been, between the years 1493 and 1509, on no less than six exploring expeditions, either as Master of Charts or commander, with Columbus, Ojeda, Vespucci, and Bastides, and had visited repeatedly the entire coast, from Paria to Uraba, and thence on his own account, north to the middle of Yucatan, as well as most of the islands in Columbus' vast Archipelago. When with Bastides, in 1501–2, he found that the Portuguese were meddling on the wrong side of the line of demarcation, endeavoring, probably, to find a shorter route to Calicut via Darien, and therefore, on his return to Spain, La Cosa was sent to Lisbon to remonstrate against this enroachment. He was there imprisoned and was not released till August, 1504. Nothing daunted, the next year, 1505–6, he went on an exploring and trading expedition of his own to Uraba and Panama, and on another similar one in 1507–8. On the 11th of November, 1509, he embarked with Ojeda from Hispaniola, and perished soon after. From this it will be seen that he might be in Spain chart-making, from June to October, 1500; from September, 1502 to 1504, autumn, (except when in prison in Lisbon); and again parts of the years 1506–7, as well as parts of 1508–9. He had, therefore, ample time, if necessary, to touch up his great chart of the world, made and dated in 1500, but a careful examination of the whole chart will show that it gives no information later than its date. The date is positive, and there is probably no reason to doubt it. But as his own discoveries and explorations west of Mont San Eufemia towards Uriba, Darien and Panama made from 1501 to 1508 are not laid down, is it not probable that the chart had passed out of the maker's possession, and was therefore beyond his reach for retouching? There are many other points for discussion, but as the writer has never had under his eye the original chart, but judges only from M. Jomard's excellent colored fac-simile on three double elephant folio sheets, he feels that he is treading on ticklish ground. The fac-similes (greatly reduced in size) given by Humboldt, Ghillany, Lelewel, Kohl and others, are in many respects defective, and tend to mislead the student, inasmuch as the coloring, and the lines of latitude and longitude are left out. Some names are misplaced and others are misspelled, while many important ones are omitted altogether. Only the western sheet or third, is given (except by Humboldt). But it should not be forgotten that the chart is intended to represent, on a plain, the entire globe as far as known in 1500. There is a broad green border above and beyond the Ganges, showing that the northeast of Asia is *terra incognita*. But La Cosa had the same authorities up to the Polisacus river and bay, in latitude 52° north that Behaim had for his globe made in 1492. Hence the two works agree remarkably well, but La Cosa, taking advantage of the seven years progress in geography, has attempted to complete Asia by laying down its northeastern coast on the other side of the globe, from somewhere about Zaiton in the Corea, to and some thirty degrees eastward, beyond the Polisacus river and bay, through the kingdoms of Gog and Magog, and thence by a dream line connecting Asia with the discoveries of the Cabots and the Cortereals. The Polisanchiu river of Fra Mauro in 1457 is the Polisacus of Ruysch and the Ptolemies of 1511, 1513, 1535, and 1540. These and the Posacus of Schoner, the Puluisangu of Ortelius, and Pulisangu in later maps, are probably the Amoor river of our day. At all events, the river and bay are in eastern Asia, are about 50° to 52° north latitude. and therefore, America on La Cosa's chart cannot extend further west than the left flagstaff, the meridian of Porto Rico. The three rivers on the three reduced fac-similes are not in the original map of La

the East, were so recognized as they placed them, and required no new general name, but their names of particular localities, such as Terra Nova and Bacalaos, were adopted. But as to the *New World* described by Vespucci, the case is different. This large country was undoubtedly new, and as his was the first description of it printed, his friends of the Vosges Mountains, lovers of geography, sought very properly, in 1507, to compliment him by giving it, instead, the beautiful name AMERICA. This was done without the knowledge of Vespucci, and was never intended to interfere with the just rights and claims of Columbus. The truth is, there was then no other book in print describing Brazil but Vespucci's very simple and interesting letter, written (but in what language it is doubtful) probably immediately after his return in September, 1502. He gave the country he described no name, but the translator into Latin entled his little tract *Mundus Novus.* But time wore on, and the mistakes of the geographers, as well as those of Columbus and Vespucci, are made apparent.*

Cosa, and on Dr. Kohl's fac-simile the important words, *Mar descubierta por Yngleses*, are placed too low down and half an inch too far west, thus conveying the idea that the English had discovered Mangi.

In short, La Cosa's coast line, from Cuba to the first flagstaff, was intended for Asia, and to this day answers better for Asia than America. The student, therefore, who is not clear on these points is liable to get the Polisacus (sometimes spelled Plisacus) Bay, the Gulf of Maine, Rio Gomez, Cathay, Memphramagog, Gog and Magog, Quinsay, Cape Cod, Zaiton, Zipangu, Capes Race and Henlopen, Mangi, Carolina, Ciambu, Florida, Chicora, Cuba, etc., into a beautiful muddle. This is no exaggeration. This utter confusion has been made by compilers and amateur geographers from the times of Hylacomilus, Apianus, Schoner, Laurence Fries, Orontius Fine, and Muenster, to the present day, and no doubt will continue so until geographers look more carefully into the chronology and bibliography of their subjects. With these explanations this map is perfectly intelligible, and is reconcilable with other good maps made since the discovery of the Pacific in 1513, when America first began to stand alone in geography independent of Asia. The question next to be asked is, how far west and south did Sebastion Cabot go in 1497–8? According to La Cosa and Ruysch, as far probably as the extent of the Gulf of St. Lawrence. Compare Hakluyt's map of 1587. Ruysch differs from La Cosa only as he had to record also the discoveries of the Cortereals. The remark of Peter Martyr, in 1515 (after their eyes were opened to the size and shape of the globe by the discovery of the Pacific) about Cabot's reaching on the American coast the latitude of Gibraltar, and finding himself then on a meridian of longitude far enough west to leave Cuba on his left, is simply absurd, dilemmatize it as you will. Such a voyage would have landed him near Cincinnati.

* A little book, hitherto unknown, written by Walter Lud, and printed at Strasburg in 1507, entitled *Speculi Orbis Declaratio*, discovered by the writer in 1862, has been the means of clearing up many unjust aspersions of historians against Vespucci, and explaining the true state of affairs. The book is now in the British Museum. The writer, after unsuccessful endeavors for two years to place it in America, at the end of March, 1864, had the great satisfaction of calling the attention of his friend, R. H. Major, Esq., to it, and pointing out to him the passages referring to the Vespucci books. How well Mr. Major has used these materials his excellent paper on the Manuscript Map of Leonardo da Vinci, printed in the *Archæologia* and his admirable *Life of Prince Henry the Navigator*, abundantly show. The next year the writer called Monsieur Harrisse's attention to it, and in his *Bib. Am. Vet.* it appears, under No. 49.

In 1505–6 northwestern Honduras aud Yucatan were seen by Solis and Pinzon, and in 1508 Juana (henceforth called Cuba) was circumnavigated by Ocampo, thus dispelling the doubt about its being Zipangu, or part of the main land of Asia. It was found to be a long, narrow island, extending east and west, and not north and south, like Zipangu. A strange confusion now began to seize the German geographers of Strasburg and Vienna. They made Cuba an island, and called it Isabella, and then transferred all the names from Isabella to a mainland, named usually, Terra de Cuba, connecting it with Paria (sometimes with and sometimes without a narrow strait) standing bolt upright, and extending to 45° north latitude, with a point like Florida, and a gulf to the west of it. This was still supposed to be part of Asia, the Florida-like projection being the Corea, and the gulf, the sinus Gangeticum, but in reality existed only in the imaginations of the geographers, like Antilla and San Brandan. It holds on their maps about twenty names, some of which are found on Ruysch's large island or main land west of Spagnola, and all of which are found on early maps, especially on a Portuguese portalano compiled by Lelewel under date of 1501–4. It is in the Ptolemy of 1513, extending up to 45° with the three-mouthed Ganges and the Gulf of Ganges, while on the globe of Schoner, of 1520, it reaches 51°, and is separated from Zipangu by five or six degrees of Balboa's newly discovered South Sea which by a strange guess is carried due north to the pole. Off to the northeast, in its proper latitude and longitude, most of these maps have Terra de Corte Real as a large island, extending probably as far as the Cabots and the Cortereals discovered—that is, as far west as the meridian of Porto Rico. Some maps have it Terra de Cuba, others Paria; and one, in the *Margarita Philosophica* of 1515, from a misreading of Columbus' first letter, Zoana Mela. This fancy continent grew in size for nearly a quarter of a century, and was hard to get rid of, but the explorations of Ayllon, Cortez, Gomez, Verranzo, Cartier, and others, finally drove it from our geographies.

In 1513 Florida, up to Chicora, was explored by Ponce de Leon, but it is now certain that it had been discovered two or three years before, probably by private adventurers, but perhaps by Ocampo in his return voyage in 1508. At all events, it appears correctly laid down in the excellent map of Peter Martyr printed at Seville April 11th, 1511, under the designation, *Isla de Beimeni.* This map, exhibiting an unbroken coast line from Cape Santa Cruz, in Brazil, to the middle of Yucatan, with hints of continental lines from Florida northward and westward, and one due north of Yucatan, if studied by the light of Peter Martyr's tenth book of his second decade, dated December, 1514, will foreshadow an approaching eclipse of Spanish enterprise in this direction.

There is little doubt that, at the time of the publication of this most important map, the author was still under the belief that all these new main lands somehow pertained to the continent of Asia. It is true, he informs us that some philosophers, and he leaves us to infer that he was one of them, had their suspicions that Columbus was mistaken in his opinion of its being Cathay, that the globe was larger than Columbus supposed, and that he had not really reached the antipodes, or the kingdom of the Grand Khan. But when Columbus, in his fourth voyage, brought home some poppinjays, and exhibited their brilliant plumage at the court, the good old gossipping letter-writer acknowledged that the great Discoverer was right, that such beautiful birds could come only from the East. Hence, probably on this map the lines west of Beimeni and north of Yucatan are dream lines from Marco Polo. Indeed, Peter Martyr says, in his first decade, finished in 1510 and printed shortly after, that all these provinces of Paria, Cariena, Canehiet, Cuquibacoa, Uraba, Veragua, and others, are supposed to pertain to the continent of India. Florida and Beimini forgotten by Marco Polo, and left out of his report! Shade of Sebastian Cabot!

In 1511 Cuba was settled under favorable auspices, and with Diego Velasquez as governor over well-to-do colonists, it became the base of operations for extensive explorations. On the 8th of February, 1517, Francisco Hernandez de Cordova, accompanied by Bernal Diaz del Castillo, he of the *True History*, and Antonio Alaminos as pilot, who as a boy had sailed with Columbus, set out on an exploring expedition to the west, to look for trade, gold, and the long-sought passage to the land of promise. He went by Cape Catoche, the bay of Campeche, as far as Champoton, and returned. The next year, 1518, on the 5th of April, Juan de Grijalva set out on the same route, with a better fleet and fuller instructions, accompanied by Bernal Diaz, Pedro de Alvarado, and the ever faithful Palinurus, Alaminos. They visited Cozumel, Cape Catoche, Campeche, Rio Tabasco, Potonchan, and named the country New Spain. They went as far as Panuco. Alvarado was sent back with the sick and heaps of gold, but Grijalva himself did not return to Cuba till the 15th of November. The journal of this important expedition, kept by the chaplain, Diez, was first published in Italian by Zorzi, at Venice in 1520, as an appendage to the *Itinerario* of Varthema.

Three days after Grijalva's return, Hernando Cortez, on the 18th of November, 1518, with the instructions in his pocket, which the governor sought in vain to recall after the return and favorable report of Alvarado, embarked on that most wonderful expedition of modern history, but he did not really leave Cuba for Cozumel till the 10th of February, 1519. He followed the courses of Cordova and Grijalva till he reached Vera Cruz. From thence he ascended the Grand Plateau, and what followed

is known to all the world. In his Second Relation, dated 30th October, 1520, Cortes sent to the Emperor a map of the entire Gulf of Mexico, well laid down, which was printed for the first time in 1524, at Augsburg, where Charles V. had resided. This map was incorporated into Orontius Fine's celebrated map of the world dated July, 1531, which, compared with the account of Megellan's voyage, and the third and fourth Relations of Cortes, led the great geographer and astronomer of Nuremburg, Schoner, the next year, 1532, to completely change his mind as to the extent of the South Sea, and place it almost entirely south of the equator, extending Asia to the north of it from the Ganges to Bacalaos, or Newfoundland. On this map of Cortes are the names of all the places at which he touched from Yucatan along the coast as far as Vera Cruz. These are, in order, Santo Anton, Roca Partida, Rio de Grijalva, Rio de la Palma, Rio de dos botas, Caribes, Santo Andres, Rio de Cocuqualquo, Roca partida, Rio de Vanderas, Rio de Alvarado, P. de Sant Juan, Seville, Almera, and San Pedro. The Rio de Cocuqualquo was surveyed for many miles, probably with the hope of finding an opening to the South Sea. In Fine's map of 1531 most of Cortes' names are indiscriminately mixed up with those of Marco Polo. [Pl. III. No. 3 and 4.]

In 1519, Francisco Garay, the Governor of Jamaica, dispatched Alonzo Alvarez de Pineda to explore the keys and coasts of Florida, but owing to the reefs and contrary winds, he directed his way round by the northwest coast by Mobile Bay, and the Mississippi river to Vera Cruz, thus completing a full and careful survey of the Gulf of Mexico. But still the disappointing report to the home government of old Spain was—no thoroughfare. Here was the eclipse. Portugal had gained a strong foothold of eight hundred miles on the coast of Brazil in consequence of removing the Line westward. In this way Spain became hemmed in between two lines of demarcation, the one the breadth of the Pope, the other the Cordilleras of the new hemisphere, the one about as impassible as the other, to the Spanish mind.

Thus all these three fields of discovery had by degrees crept into one vast continent, extending from the Arctic to the Antartic Circles, and, instead of being India, the land of fabulous treasures, it was an impassable barrier to the approach thither by the western route. In 1513, when Vespucci had been in his grave a year, and Columbus seven, Nuñez de Balboa first saw the Pacific Ocean (for many years called the South Sea) from the mountain tops of Panama, and soon after navigators began to realize that the land of spices was beyond another ocean, even more vast than the Atlantic itself. The beautiful name AMERICA now began to swallow up the conjunctives, to spread itself

eventually all over the new hemisphere, by the same law that made the Libya of the Romans succumb to its younger and more beautifully named daughter, AFRICA.

But Spain, with her new Emperor, her Fonsecas, her Corteses, her Pizarros, her Almagros, her Don Quixotes, her affluent mis eries, her newly awakened thirst for gold, her Christian zeal, and her jealous rivalry for possession of the Spiceries, was not the power to bend or break. She redoubled her energies, made laws for the regulation of her half of the world, and pious and unscrupulous as they were, systematized her efforts. She would not permit the Portuguese to seek a passage to their eastern possessions through her half by the way of the Isthmuses of America, and by the same rule she felt a delicacy in using their route by the Cape of Good Hope. Her ambassadors and agents in foreign countries manifested no such scruples.

In 1512 or earlier, Sebastian Cabot was seduced from England, and induced to take service, with his experience, in Spain; and the same year Juan de Solis, exploring the coast of South America, discovered Rio de la Plata. In 1515 he was again sent thither with a view of finding a passage to the South Sea, and thence to the Moluccas. This expedition returned soon after in consequence of the death of Solis, but it led the way to a successful one in 1519, under Magellan, a disaffected Portuguese gentleman who had served his country for five years in the Indies under Albuquerque, and understood well the secrets of the Eastern trade. In 1517, conjointly with his geographical and astronomical friend, Ruy Falerio, another unrequited Portuguese, he offered his services to the Spanish court, At the same time these two friends proposed not only to prove that the Moluccas were within the Spanish lines of demarcation, but to discover a passage thither different from that used by the Portuguese. Their schemes were listened to, adopted and carried out. The Straits of Magellan were discovered, the broad South Sea was crossed, the Ladrones and the Phillipines were inspected, the Moluccas were passed through, the Cape of Good Hope was doubled on the homeward voyage, and the globe was circumnavigated, all in less than three years, from 1519 to 1522. Magellan lost his life, and only one of his five ships returned to tell the marvelous story. The magnitude of the enterprise was equalled only by the magnitude of the results. The globe for the first time began to assume its true character and size in the minds of men, and the minds of men began soon to grasp and utilize the results of this circumnavigation for the enlargement of trade and commerce, and for the benefit of geography, astronomy, mathematics, and the other sciences. This wonderful story, is it not told in a thousand books? The Spanish eclipse was now passed, and America not long after stood boldly out as an independent hemisphere.

Meanwhile the Spaniards were timidly tempting their new ocean. The South Sea shores of Darien, Panama, and Veragua were explored in 1515 to 1517, as they had been a few years before on the north side, with a view of finding a water communication from ocean to ocean. Estevan Gomez, another decoyed Portuguese pilot in the service of Spain, who went with Magellan in 1519 as far as the Straits and there discreditably deserted him, returning to Spain in 1521, reported that, though a strait had been found by the admiral, it was too remote and too dangerous for use. It was resolved, therefore, to seek for the supposed isthmian passage by a more thorough examination of the coasts of the Pacific. Accordingly, in 1522, four vessels having been built at Panama, Avila and the pilot Nino set out to explore the coast from the Bay of San Miguel to the Gulf of Fonseca, expecting to find at the latter place a passage by water through to the Gulf of Honduras.

The same year Cortes, after having subjected the mighty barbaric empire of Montezuma, extending from the Atlantic to the Pacific, with characteristic energy set himself to work exploring to find a natural water passage, or to make an artificial one. He ordered four ships to be built at Zacatula, two for direct trade to the Moluccas, and two to search for the strait. The voyage to the Moluccas was postponed, but the search for the strait was prosecuted so vigorously that, between the expeditions of Avila and his own, every inlet was explored between Colima, in latitude 18½° North, and the Bay of San Miguel, a distance of above 2,500 miles of coast line, but of course without finding any passage. The following year, 1523, Cortes is said to have dispatched five small vessels to reconnoitre the coasts from Florida northward, to seek for the passage connecting the two oceans. His plan was to send another fleet up the western coast that they might meet somewhere north of the German geographer's fancy continent, or sail round it. Of course they never met.

In 1524, Pizarro and Almagro, the future conquerors of Peru, began their approaches thither from Panama, carrying with them always the impossible instructions to seek out the hidden passage, while they were looking for trade and searching for gold.

The Portuguese in India and the Spiceries, as well as at home, now seeing the inevitable conflict approaching, were thoroughly aroused to the importance of maintaining their rights. They openly asserted them, and pronounced this trade with the Moluccas by the Spanish an encroachment on their prior discoveries and possession, as well as a violation of the Papal Compact of 1494, and prepared themselves energetically for defense and offense. On the other hand, the Spaniards as openly declared that Magellan's fleet carried the first Christians to the Moluccas,

and by friendly intercourse with the kings of those islands, reduced them to Christian subjection and brought back letters and tribute to Cæsar. Hence these kings and their people came under the protection of Charles V. Besides this, the Spaniards claimed that the Moluccas were within the Spanish half, and were therefore doubly theirs. Accordingly great preparations were made to dispatch a fleet of six new ships to the Moluccas, to establish and protect trade. The Council of the Indies advised the Emperor to maintain this fleet there, and to take the Spiceries into his own hands, and carry on commerce and navigation thither through his own exclusive channels, either by the strait recently discovered by Magellan, or by some hidden one which *must* soon be disclosed (if any reliance could be placed on the geographers) in a more direct line through some one of the Isthmuses; or, failing that, by opening communication from the coast of the Pacific.

Matters thus waxing hot, King John of Portugal begged Charles V. to delay dispatching his new fleet until the disputed points could be discussed and settled. Charles, who boasted that he had rather be right than rich, consented, and the ships were staid. These two Christian princes, who owned all the newly discovered and to be discovered parts of the whole world between them by deed of gift of the Pope, agreed to meet in Congress at Badajos by their representatives, to discuss and settle all matters in dispute about the division of their patrimony, and to define and stake out their lands and waters, both parties agreeing to abide by the decision of the Congress.

Accordingly, in the early spring of 1524, up went to this little border town four-and-twenty wise men, or thereabouts, chosen by each prince. They comprised the first judges, lawyers, mathematicians, astronomers, cosmographers, navigators and pilots of the land, among whose names were many honored now as then—such as Fernando Columbus, Sebastian Cabot, Estevan Gomez, Diego Ribero, etc. They were empowered to send for persons and papers, and did in reality have before them pilots, Papal bulls, treaties, royal grants and patents, log books, maps, charts, globes, itineraries, astronomical tables, the fathers of the church, ancient geographies and modern geographers, navigators with their compasses, quadrants, astrolabes, mathematical instruments, etc. For two months they fenced, cyphered, debated, argued, protested, discussed, grumbled, quarreled and almost fought, yet they could agree upon nothing.

Whereas in the treaty of 1494 the Portuguese claimed the right of placing the line farther west than 370 leagues from the Cape Verde Islands, while the Spaniards contended rather to carry it farther east than placed in the original bull, both parties now (so much does self-interest sometimes modify arguments of

right) contended for the very opposite to their former arguments. The line, however, had been fixed on and approved by the Pope in 1494, and therefore could not be altered by them. But as there were 150 miles between the most easterly and most westerly of the Cape Verde Islands, they discussed angrily as to which island the line should pass through, each party knowing that every mile the line was moved here to the east or west, it would necessarily have to be moved just so much at the antipodes, the real field in dispute.

The debates and proceedings of this Congress, as reported by Peter Martyr, Oviedo, and Gomara, are very amusing, but no regular joint decision could be reached, the Portuguese declining to subscribe to the verdict of the Spaniards, inasmuch as it deprived them of the Moluccas. So each party published and proclaimed its own decision, after the Congress broke up in confusion on the last day of May, 1524. It was, however, tacitly understood that the Moluccas fell to Spain, while Brazil, to the extent of two hundred leagues from Cape St. Augustine, fell to the Portuguese. The calculation of longitude was the *pons asinorum* of the Congress, the very problem that had deceived Columbus and other experienced navigators a quarter of a century before. At this time let it be remembered, no geographer had given any hint of the fan-like shape of North America, but all maps represent it as a narrow strip of land, like that from Panama to Tehuantepec, with the South Sea itself narrow running up to the west of it.

However, much good resulted from this first geographical Congress. The extent and breadth of the Pacific were appreciated, and the influence of the Congress was soon after seen in the greatly improved maps, globes, and charts. Many doubtful points in geography and navigation were cleared up on both sides of the globe, and the latitude and longitude of many places were defined. Indeed, on the new maps after this, all the discoveries actually made, up to 1524, were tolerably well laid down, but there was a deal of imposition left in the imaginary lines of those parts of the North American coast which had not yet been explored, that is, between Florida and Nova Scotia. These false lines were still used by the pilots of both Spain and Portugal, probably with a view of blinding the eyes of each other, or leading astray the outside barbarians of England, France, and Holland, who, though children of the Father, and given to trade and adventure, had no share in the Papal gratuity. The fact that all the coasts of South America, Panama, Nicaragua, Honduras, Yucatan, the Gulf of Mexico, and Florida, as well as of the Pacific shores from the Gulf of San Miguel to Colima, that had been surveyed by the Spaniards up to this time, were well laid down, both as to latitude and longitude,

proves almost to a certainty that the indefinite coast line of the United States was still imaginary, if not Asiatic. Indeed, the old wood-cut maps of 1513 and 1522 of the German geographers, with their ideal continent, Terra de Cuba, did service, without alteration in the Ptolemies, for a quarter of a century later.

The return of Magellan's ship Victoria in 1522 aroused the spirit of public and private enterprise throughout Spain. Innumerable schemes for developing commerce with the Orient, and making further explorations, were proposed and discussed. Every pilot, whether amateur or practical, had his card of the shortest route to the Indies. Of these schemes no less than six in 1523 and 1524 were adopted by the government, and promoted wholly or in part by public funds; viz., that of Cortes, of Loaysa, of Gomez, of Ayllon, of Cabot, and of Saavedra. The impending conflict with Portugal called together the Congress of Badajos. That being over by the 1st of June, 1524, and resulting practically in favor of Spain, these several plans were matured as fast as practicable.

Cortes, the first and most active, had no sooner conquered Mexico and clenched his conquest than he began his exploration of the coasts of the Pacific. Without delay he sent Alvarado and other captains to the south and southeast, to bring into subjection the chiefs of the Province of Oaxaca and what is now called the Isthmus of Tehuantepec, and, shortly after, proceeded thither himself.

Ships were built on the Pacific side, but with many of the materials carted over from the Coatzacoalcos River. All the details of this scheme, from the 15th of May, 1522, to the 15th of October, 1524, are recorded in Cortes' Fourth Relation to the Emperor, printed at Toledo, October 20th, 1525. This Relation in Spain, with the reports of Alvarado and Godoy attached, gave still another impulse to the new speculations and enterprises, as it showed not only the practicability, but the probability of opening by artificial means a direct route to the Orient in a low latitude and good climate. Cortes was clear-headed and far-sighted enough to see that lines of commerce must be straight lines, and that the curves of the capes in high latitudes are only temporary matters of necessity. Indeed, so sanguine was Cortes on these points, that he planted his personal hopes and private fortune on and near this isthmus, as likely to become the Old World's highway for Oriental commerce. All the lands and private estates selected for himself and his posterity, and confirmed to him in 1529 by the Emperor, were located here in the Valley of Oaxaca, and near Tehuantepec. He was ennobled in 1529, taking his title, Marquis del Valle, from his possessions chosen here. To this day they are called the Cortes Estates, or the Marquisanas. He and his

kinsman, Saavedra, had vast schemes for opening communication, by means of a ship canal or Roman road, for the transportation of merchandise brought hither from the Moluccas and other parts of the East for passage or transhipment to Spain. How unexpectedly this rational scheme was thwarted will appear farther on.

At the end of 1524 or early in 1525, Estevan Gomez, the pilot who had been in the East, had started with Magellan and deserted him, a delegate to the Congress of Badajos, was the first to get off from Spain. He had boasted that he could find a passage to Cathay and the Spice Islands by the north, as Magellan had done by the south. He must have seen at Badajos, if not before, the maps of Ruysch, with the continent west of Spagnola extending to 35° north, and the Hylacomylus map of 1513, carrying the same ideal continent up to lat. 46°, ending with Cape Mar del Oceano, just above Ruysch's Cape Helicon (probably named from the rumored fountains of Florida). Peter Martyr's map of 1511, and Cortes' map of 1520, printed in March, 1524, together with the knowledge that Ponce de Leon, in 1513, and Ayllon, in 1520, had explored the coast of Florida up to 33° 40′, a little above Charleston; and it being known that Ayllon had another commission in his pocket, dated June 12, 1523, to explore still further north of Florida; and his own commission being to find a strait between Florida and Barcalaos; these considerations make it certain that Gomez' field of search lay between 35° and 45°, or between Norfolk and Cape Sable, where, as Peter Martyr expresses it, "he found pleasant and profitable countries agreeable with our parallels." Very little is known about this unimportant expedition, and no authentic maps or papers have come down to us. The contemporary historians give no prominence to it, and very few facts about it. Indeed from what is at present known, it is very difficult to tell whether Gomez sailed up or down the coast, or both, or at what points he touched. So little information did he bring back, that it would not now be a matter worth discussing if the results of the voyage had not been so enormously exaggerated by recent writers.

Let it be borne in mind that Gomez sailed with only a single caravel of fifty tons, with perhaps a dozen men, in the dead of winter, from Coruna, in lat. 43°, the government contribution toward the cost of the fit-out being only 750 ducats, returning in November, 1525, after an absence of about ten months, with some Indian slaves, whom he had kidnapped against a recent law of Spain and the positive instructions of the Emperor, and you have the whole story. Oviedo, writing in 1526, says that he sailed to the northern parts and found a great part of land continuate from that which is called Bacalaos, taking his course

toward the west to 40° and 41°, from whence he brought certain Indians. Would an intelligent pilot sail north with such a craft in winter? Might not New England be the "great part" of land next to Bacalaos; and might not the fine tall natives of Rhode Island have been kidnapped, part being taken to Cuba for sale, the rest taken to Toledo, thus consuming the ten months, without having gone north of Cape Cod? Peter Martyr says, writing also in 1526: "He, neither finding the strait nor Cathay, which he promised, returned back within ten months from his departure. I always thought and presupposed this good man's imaginations were vain and frivolous." Herrera, who wrote three quarters of a century later, is hardly more favorable to this explorer.

The reader is referred, by recent writers, to the manuscript map of Ribero of 1529, now preserved at Weimar, for the result of Gomez' voyage. But the intelligent reader will see with half an eye that this is a partizan map, and intentionally deceptive in the coast line between 33° 40′ and 50° N. The discoveries of the English are thrown into Greenland, and called Labrador, while Bacalaos is given to the Portuguese, and cut off by the line of demarcation. All the rest of the coast is closed up under the names of Gomez and Ayllon, and so given to Spain. There is no room left for the discoveries of Verazzano for the French in 1524. The Spaniards knew of his voyages, for they had been watching him, and caught him, and in 1527 hanged him as a corsair. Indeed, the best that can be reasonably said of the voyage of Gomez is, that it exploded the ideal continent of the German geographers, and, connecting the explorations of Ayllon with New England, showed that the coast of North America trended continually eastward, so as probably to connect it with the discoveries of the Cabots, and thus make the whole coast west of the Line Spanish.

Lucas Vasquez Ayllon, a lawyer, a Senator in Hispaniola, and a man of position, immediately after the survey of the entire Gulf of Mexico under Grijalva and Cortes, sent an expedition up the coast of Florida in 1520, as far as Chicora, exploring beyond the limit of Ponce de Leon, as far, probably, as Cape Fear, seeking for the passage to Cathay. He found a fine country, but to Asia no thoroughfare. The next year he returned to Spain, and was, according to Peter Martyr, in behalf of the Regency of Hispaniola "a long time suitor [to the Council of the Indies] to have leave to depart again into those countries, to build a colony there." At length, after the return of Magellan's ship Victoria with its glorious news, the Council granted his request, and articles of agreement were signed the 12th of June, 1523, giving him permission, at his own expense, to fit out as many vessels as he pleased for the purpose of plant-

ing his proposed colony, but the usual instructions were inserted in his grant, to explore all inlets and islands with a view of finding a passage to Cathay. This license, given by Navarrete, permitted him to explore as far as 800 leagues to the north of Hispaniola. He returned to Hispaniola, built there six fine vessels, and, after many delays, sailed with them and above 500 men and nearly 100 horses, in July, 1526. He went as far north as lat. 33° 40′, found no strait, and met with nothing but misfortunes. The 18th of October Ayllon died, and soon after the few survivors, about 150 out of the 500, returned to Hispaniola, the expedition being a dead failure. Thus ended the attempt to plant a colony near the mouth of Cape Fear River, and thus ended the Spanish attempts to penetrate to the East by the way of the North. Both Gomez and Ayllon had found no gold, and no strait, and even the trees and animals they reported were common in Europe; whereat old Martyr exclaims, "to the south! to the south! for the great and exceeding riches of the equinoxial; they that seek riches must not go unto the cold and frozen north." The whole story is comprehended in Martyr's sentence. North America, by the Spaniards, was never considered of any consequence of itself, and was regarded only as a barrier or a stepping stone to a richer, older and better land. It was necessary, however, to shut it up by a coast line west of the line of demarcation, so that other nations might be deterred from finding a northern passage to India.

The Emperor, considering the verdict of the Congress of Badajos in his favor, lost no time in dispatching his new fleet of six sail and 450 men by the Straits of Magellan, from Coruna, on the 24th of July, 1525, under the command of Loaysa, to the Moluccas and the Spice Islands, with the view, first, to succor the men left there by Magellan's fleet, and then to establish a government bureau and to protect its commerce. The Straits were passed, and four of the six ships reached the Moluccas; but the story of their long, long sufferings is too long to be told here.

In April, 1526, Sebastian Cabot, who had for years been the Pilot Major of Spain—said, however, to have been a better cosmographer than pilot—after long and ample preparations at Seville, sailed for the Moluccas via the Straits of Magellan, with four well-equipped ships, for the purpose of reinforcing and assisting the expedition of Loaysa. This expedition was another dead failure. For some unaccountable reason, Cabot did not deem it prudent to try the Straits of Magellan, but attempted to find a passage through the Rio de la Plata. He penetrated far into the interior of Paraguay, explored many large rivers and fertil provinces, suffered many hardships, lost most of his men and ships, and finally, after four years of toil and disappointment, returned without any favorable results.

Cortes was kept informed of these several expeditions, with a request from the Emperor that he would coöperate with them at the Moluccas, by sending a fleet from the western coast of Mexico. Accordingly he caused three ships to be built on the Pacific, and dispatched them, with 110 men and thirty pieces of artillery, under command of his kinsman, Saavedra, from some port of Southern Mexico, probably Tehuantepec, Huatulco, or Acapulco, on the 31st of October, 1527. This fleet met that of Loaysa in the Moluccas, coöperated with it, found the Portuguese strong and resolute, by no means disposed to abandon the islands, fought them separately, and fought them together for months, nay, for years, never hearing a word from home, being cruelly neglected, yet loyal and true, till reduced to a handful, some few of the survivors, long after Loaysa and Saavedra had died, as well as most of the sub-officers, found their way home after twelve years of unspeakable hardships. Thus all these six hopeful expeditions brought nothing but disappointment. The Straits of Magellan were found so dangerous and remote, that old Peter, had he lived, would no doubt have again exclaimed as before, "To the north! to the north! they that seek riches must not go to the dangerous and frozen south!"

As early as 1526 or 1527, before the extent of these failures was known, it became apparent, if the commerce of the East was to flourish, it must be by some more direct communication. These great difficulties of the extreme North and South determined the Spaniards to explore the Isthmuses yet more thoroughly. All the five routes from Darien to Tehuantepec, were spoken of then as now, with the view of constructing immediately a canal, road, or portage, deeming it safer and cheaper to tranship goods, than to carry them round by the Strait. "There are mountains it is true," exclaimed the old historian, "but Spanish hands, and Spanish enterprise can overcome them." But no Spanish hands could overcome the impolitic blunders of the Emperor. There is little doubt that inter-oceanic communication would have been opened in 1529 or 1530, by means of a ship canal or a turnpike across the Isthmus of Tehuantepec, had not the Emperor, who was greatly in want of money, defeated all the schemes against the advice of the Council of the Indies, by pawning in the treaty of Saragossa to the King of Portugal who had just married his sister, the Moluccas for 350,000 ducats. So the trade of the Moluccas passing for a time out of the hands of the Spaniards, there was no immediate pressure for the completion of this great work. The opportunity then lost of securing an exclusive transit was never recovered by Spain, but it is reserved to us of to-day to make the Isthmus of Tehuantepec the world's highway.

H. S.

May 10, 1869.

ART. XXX.—*Summary of Results of a late Geological Reconnoissance of Louisiana;* by EUGENE W. HILGARD, of the University of Mississippi.

THE geological reconnoissance of a large portion of West Louisiana, the results of which I propose briefly to discuss, was made under the auspices of the New Orleans Academy of Sciences. The means required for outfit and traveling expenses were provided partly by subscription (chiefly among the members of the Academy), partly by an appropriation, made in furtherance of the object in view, by the Board of Immigration for the State of Louisiana. The time at my disposal for the purpose was, unfortunately, limited to thirty days; but in view of the presumable close correspondence of the formations of Louisiana to those of Mississippi, previously well known to me, as well as the information already in my possession as the result of a previous exploration made under the auspices of the Smithsonian Institution, I was led to anticipate that even a rapid reconnoissance would enable me to determine with sufficient precision, the chief characteristics and geographical outlines of the formations. I was accompanied and materially assisted by Dr. J. K. Walker, of New Orleans, a Fellow of the Academy, and Mr. Scott Miller, of the same city, who volunteered to take charge of the pack mule needed to carry specimens. The entire distance traversed on horseback was 625 miles, and the route was so chosen as to cross the presumable strike of the strata, as often as possible, while touching the most important known points of interest. Passing by the interesting chain of islands previously examined by me (Petite Anse, Côte Blanche, etc.), the party proceeded from New Iberia on the Têche viâ Opelousas to Bayou Chicot, where the border of the older formations was reached; thence west to the Calcasieu river, down that stream to Lake Charles and the sulphur and petroleum wells on the West Fork of the Calcasieu river; thence north to Sabine Town, Texas, thence viâ Manny to Mansfield, La., thence crossing Red river at Coushatta Chute Landing to the salines on Saline bayou, and thence viâ Winfield to Harrisonburg on the Washita river, where, after some excursions in the neighborhood, the expedition terminated.

While the presumption as to a general arrangement of the formations in bands, more or less parallel to the Gulf coast, proved to be substantially correct, yet in consequence of local deflections and differences presently to be discussed, the section obtained on the route just recited was less complete than I had hoped. It has, nevertheless, served to develop pretty fully the

main features of the geology of the whole of Louisiana. The unexplored territory will probably, before the end of the season, have been surveyed by Profs. Lockett and Hopkins, of the Louisiana State Seminary at Alexandria, in pursuance of a small provision made for the purpose by the last legislature.

Before proceeding to details it may be well to recall, briefly, the results communicated at the last meeting, of my examination of the formations of Lower Louisiana. I then stated that the southern outline of the main body of the Orange Sand or southern Drift, extends but little south of the limit of the Grand Gulf group, the latest (fresh-water) Tertiary of the Gulf coast; that, nevertheless, in the direction in which the main pebble-stream, coincident with the axis of lowest depression of the Mississippi valley would strike the Gulf, we find a chain of elevations, formed, apparently, by a nucleus of outliers of the Orange Sand materials, surrounded and overlaid by those of the succeeding swamp, lagoon and estuary formation, which from its prominent development at Port Hudson, I have designated as the Port Hudson group; its geological horizon lying between that of the Orange Sand, and the Loess or Bluff formation. I also stated that the deposits of this age extended at least from the Sabine River to Mobile Bay. In fact, I then suspected, and am now confirmed in the opinion, that most if not all the deposits provisionally thrown together under the head of "Coast Pliocene," on my geological map of Mississippi, are the equivalents of the Port Hudson group.

The Port Hudson group.—East of the Mississippi river, the country underlaid by this group of deposits is level or gently undulating, with a gentle slope S.S.E.; the more fertile portions timbered with oak, while on the whole there is probably a predominance of Long-leaved Pine woods, at times degenerating (as in the coast region of Mississippi) into the wet and sterile "Pine meadow" uplands, where the Pine and Cypress grow side by side, greatly damaged by their mutual concessions as to habitat.*

West of the Mississippi, the topographical features are on the whole similar; but instead of being wooded, the surface is almost altogether occupied by prairies, from the Bayou Tèche to the Calcasieu river, and from the marshes of the Gulf coast to an undulating line laid, in a W.S.W. direction, through Ville Plate in St. Landry parish. In correspondence with the portion east of the river, the general slope here appears to be S.S.W., the Port Hudson bluff having its counterpart in those which, abutting upon the bayou Cocodrie below and above Opelousas, have given to very level regions the seemingly inappropriate names of "Côte Gêlée" and "Grand Côteau des Opelousas"; which are descriptive of the appearance when first approached

* Miss. Rep., p. 368.

by water, rather than of the nature of the country itself. As may be supposed under the circumstances, outcrops are exceedingly scarce throughout the prairie region. The wells are shallow, remaining usually within the limits of the upper (silt and loam) strata of the Port Hudson profile; since fetid, undrinkable water is obtained at greater depths, in dark colored clays with fossil wood. Nearer the coast, however, marine beds with oysters, "clams" (*Gnathodon*) and gasteropods are also struck not uncommonly, both near the surface and at greater depths, from the Calcasieu to the Pascagoula river. I have been unable to detect any regular stratigraphical relations between these marine beds and the cypress swamp deposits; they appear to be coördinate and substantially coëval, denoting the coëxistence of littoral cypress swamps, marshes, lagoons and estuaries; just such as would naturally result from a gradual depression of the present coast.

The thickness of this formation near the coast seems to be very considerable. In one of the bored wells on the West Fork of Calcasieu, the materials of the Orange Sand were struck at 160, in the other at 354 feet (see profile below). If such is the thickness of the Port Hudson strata at a distance from any great channel, it cannot be surprising that, in the well bored at New Orleans, in the main channel of the Mississippi valley, it should not have been passed through at 630 feet. Nor is it surprising that, in that great continental depression, marine strata should prevail almost exclusively, when it is considered that at one epoch of the period of slow depression, the swamp formation extended as high as near Memphis on the Mississippi, and Shreveport on Red river.

The banks of Red river in the lake country above Nachitoches (and, according to reliable information, at least as high as Shreveport), as seen at low water, consist of materials scarcely distinguishable from those forming the profile of the sea-face at Côte Blanche.*

There are alternations, every few feet, of stiff red, blue, green or brown clays, with sand or reddish loam; often containing calcareous concretions, sometimes even well preserved fresh-water shells; as well as successive generations of cypress stumps. At the present time, neither the material nor the arrangement of the Red river deposits present any similarity to these strata, any more than do the modern Mississippi deposits to those of Port Hudson; while their thickness, regularity and continuity over large areas, as well as the rarity of stratification lines, distinguish them from the comparatively limited cypress swamp deposits of the present time.

The prairies of South Louisiana, underlaid by the Port Hudson group, embrace, especially in their southern and eastern

* Proceed. Am. Assoc., Chicago meeting, 1868, p. 327.

portion, the most fertile uplands of the state; the region adjoining the Bayou Tèche having, in times past, received and deserved the title of the "Garden of Louisiana"; not inferior in fertility to the bottom lands, and in point of health and comfort much preferable to the latter. From their exposure to the seabreeze, their summer temperature is much less oppressive and injurious to health, than is the case on the prairies of the Northwest; while their bland winter relieves the inconvenience arising from scarcity of wood. Belts of timber, however, border all the streams; and rapidly growing hedges of the Cherokee rose obviate, in a great measure, the necessity for costly wooden fences. Yet the greater portion of this preëminently agricultural region is now merely a range for herds of cattle. West of the Mentau waters, cattle-raising is almost the only occupation of the inhabitants, except near the coast; the white "crawfishy" soil, dotted with clumps of pine, being mostly unfit for cultivation—yet very far from being the dreary marsh, accessible only on stilts or in canoes, and peopled by alligators, which our maps represent as covering most of Calcasieu.

The Orange Sand Formation.—I have heretofore stated that this important series of deposits, seems, west of the Mississippi, to skirt the southern border of the highlands of Arkansas, and to be extensively represented in Louisiana. The latter presumption I have found abundantly verified, since it is as characteristically developed in the latter State, as in the corresponding portion of Mississippi. Outside of the river bottoms and adjoining "hommock" flats, and of the prairies of the Port Hudson group, just described, it appears on all the hill lands, especially on the higher ridges; which are, as usual, capped by rocky knolls of ferruginous sandstone, while slaty fragments of the same strew the slopes. A description of its general features in Louisiana would be, in every respect, a mere repetition of that already given in my Mississippi Report, and other papers since published.* I have, however, to add some facts concerning its general distribution, both horizontally and vertically.

My own observations on this formation have been confined chiefly to the great delta-shaped mass which covers Mississippi, Louisiana, and a portion of the states of Tennessee, Alabama and Arkansas, which bears such obvious relations to the great embayment whose axis is now occupied by the Mississippi river below Cairo, but which was already impressed upon the continent in ante-cretaceous times. Tuomey† and myself,‡

* This Journal, May, 1866; ibid, Nov., 1866, ibid, Jan. 1869.
† Second Report on the Geology of Alabama, p. 146, et al.
‡ Mississippi Report, 1860, p. 27.

however, have early suggested the probable equivalence of these beds with the detrital deposits of the southern Atlantic States, and the universality, in North America at least, of the cause which produced them. No one as yet, has taken up the subject in those States; much as we hear of the Northern Drift, the very existence of the Southern Drift has thus far been studiously ignored in all text-books. Yet it determines the character of the surface, not only of the greater part of five States, above mentioned, and of an important belt along the Atlantic coast, but I have now traced it in its characteristic development, across the Sabine river into Texas, and from scattered observations partly contained in United States and Texas geological reports, partly communicated verbally, I am satisfied that it forms an important feature of the geology of Texas, at least as far south as the Colorado river, and from the escarpments of the Llano Estacado to the Gulf of Mexico. How much farther it may follow the outline of the Gulf—what part, if any, it plays in the Tierra Caliente of Mexico, must hereafter be determined. At all events, its wide distribution alone assigns it a most important place among the formations of the Southwest, and this importance is greatly enhanced by its hypsometrical relations, as I have lately observed them.

I have stated in previous papers, that the depression of the lower Mississippi valley during the "Champlain" epoch cannot have been *less* than 400 feet below its present level—probably, taking into account the depth of water required for the deposition of the materials of the Loess of Louisiana, it must be estimated at fully 450 feet at least. This supposes that the depression commenced from a horizon near the present tide level. But it will be seen by reference to the profile of the Calcasieu bored wells, that in one of them, the Orange Sand had not been passed through at 450 feet below tide level, and near that depth it still contained pebbles requiring for their transportation a considerable velocity of current. The somewhat startling, but inevitable conclusion is, that if the sea level was the same then as now, *the Gulf coast has in late Quaternary times suffered a depression to the extent of at least nine hundred feet* (perhaps more), *and during the Terrace epoch, a contrary motion to the extent of about half that amount.*

The Mississippi river at the present time transports only sand; and were we to construct a general surface level from the northern lake country to the hills of the Gulf border, the fall of water flowing on the surface would still be inadequate to accomplish much more than this. But the nature, both of the surface on which the Orange Sand was deposited, and of

the deposits themselves, prove the action, especially at first, of *violent* currents, capable of transporting pebbles of several pounds weight, hundreds of miles from their original site.* It follows (always provided that the ocean level remained sensibly constant) that the 900 feet change of level, at the mouths of the Mississippi, must have been accompanied by a considerably greater change near its head, one which would more than suffice, at the present time, to establish water communication between the Gulf of Mexico on one hand, and the Gulf of St. Lawrence, as well as (through the ancient channel described, at the Chicago meeting of the Association, by Gen. G. K. Warren) with Hudson's Bay and the Arctic basin on the other; sufficiently great to explain the glaciation of the continent, as well as the succeeding fresh-water flood, whose effects are no less prominent in the southwestern portion of the North American continent, than those of the glaciers are in the northern. And it seems probable that the detailed study of this formation and of its relations to preceding and succeeding deposits, over its wide area of occurrence, is likely to give more important information concerning the geological events immediately preceding our present epoch, than can be gathered from the local accidents of ancient beaches. For while the *presence* of the latter irrefragably proves a *positive*, their *absence* fails to prove a *negative*. Unless absolute continuity is proven, the 30 feet beaches of southern New England cannot be taken as evidence that at Montreal the depression was greater in proportion to the present elevation of its highest beach; or that the (minimum) depression of 450 feet did *not* extend to the Atlantic coast: any more than that highest beach itself can be taken as the mark of maximum depression. Under the rigor of an arctic climate especially, many circumstances might concur to prevent the formation of beach lines, or cause their removal subsequent to deposition. If we assume the glacial epoch to have resulted chiefly or wholly from an uprising of the land, (and perhaps of the sea-bottom also) in northern latitudes, the wide distribution of its effects *there* points to a universality and uniformity of cause, quite analogous to that which seems to obtain in reference to the southern or Stratified Drift, from the Susquehanna to the Colorado of Texas; and (as regards the maximum of reported change of level) from the Gulf of Mexico to the Arctic coast. It is permissible to infer, that these great events were not confined to the Atlantic slope; and that the auriferous gravel beds of California are, in all probability, the strict equivalents of the "Orange Sand" of Mississippi; while the period of time required to cover the pebble

* See Mississippi Rep., 1860, pp. 13, 26, et al.

streams of Louisiana with many hundred feet of swamp and marsh deposits, may well embrace the successive lava streams now overlying the gravel of California.

The Grand Gulf group.—The materials of this formation characterize, more or less, the portion of Louisiana lying northward of the prairies of the Port Hudson era, up to a line laid in a W.S.W. direction, through Cloutierville on Red river; where, at the foot of elevated ridges consisting of Grand Gulf sandstones and claystones, the limestones and marls of the Vicksburg Eocene Tertiary begin to prevail.

The features of the Grand Gulf group in Louisiana are almost absolutely identical with those prevailing in Mississippi.* In the more southerly portion of its area of occurrence, its materials are hard, intractable blue, green or gray, massy clays or clayey sands, appearing chiefly in the beds of streams, and thickly overlaid by the deposits of the Orange Sand; to whose lower portion it has communicated its clayey character, resulting in the formation of excellent potter's clay. On the higher ridges, the ferruginous sandstone of the Orange Sand prevails largely and characteristically.

Farther northward, however, as in Mississippi, gray or white, mostly soft and somewhat clayey, sandstones, alternating with siliceous claystones of various degrees of induration, and gray, sometimes lignitic, but mostly massy clays, themselves constitute the ridges, forming rather barren soils, on which the long-leaved pine and coarse grasses alone can find sufficient nutriment. Yet even here, wherever a particularly prominent ridge or knoll is seen, it is sure to consist of an outlier of Orange Sand, perched on a plateau of Grand Gulf rock and capped by a ledge of ferruginous sandstone.

As regards the general arrangement of the strata, they doubtless dip slightly to the southward; though it is difficult to observe this in any one outcrop. Probably the dip is but slightly greater than that of the average surface of the country, for I have found nothing to indicate that the sand and claystones which form the ridges on the northern border of the formation, underlie the clays found on the southern edge. My impression is that the former have either never been formed in the latter region, or else have been subsequently removed.

My hopes of finding, in the reported limestone deposits on the territory of this group, a clue to its position in the Tertiary series,† have been disappointed. The limestone of St. Landry proves to be a Cretaceous outlier: while that occurring near Harrisonburg, capping the highest hilltops of Sicily Island,

* Mississippi Report, 1860, p. 147; this Journal, Jan, 1867, p. 39.
† This Journal, Jan., 1869, p. 9.

consists of the gnarled and knotted concretions characterizing the Bluff formation ("Loess-puppets"), which contain the Helices usual in that group. Faint and usually irrecognizable impressions of leaves sometimes occur, as is the case in Mississippi; but in the present condition of phyto-palæontology, little can be hoped for from that slender source. In its stratigraphical, lithological and structural characters, it differs widely from all the other tertiary deposits of the Southwest; its slight dip alone proving it to be of comparatively modern origin. Whatever may be the precise epoch of its formation, that event could not have been a local one, due only to a littoral shallowing of the Gulf. The regularity, as well as the uniformity of composition of the strata, from the Escambia river to the Colorado of Texas, alone seems to forbid its being considered, like the Port Hudson deposits, as the representative of a period of swamp and estuarian formations on the border of a marine basin. I have heretofore suggested,* that nothing short of a temporary cutting off of the Mexican gulf from the Atlantic seems capable of accounting for the existence of the Grand Gulf strata; and this impression has been nowise weakened by a more extended acquaintance with this remarkable formation.

While the territory of the Grand Gulf group is on the whole perhaps the least fertile portion of Louisiana, (as is likewise the case in Mississippi), there are some notable exceptions to this rule, in regions where a calcareous clay stratum† comes so near the surface as to contribute to the formation of the soil on the hillsides and in the bottoms. Such is the case on the upper bayou Anacoco (in the "Anacoco prairie" region) as well as in the southern portion of Sicily Island, near Harrisonburg on the Washita. Whether the Avoyelles prairie belongs to the same category, I have been unable to ascertain; but from its position it seems likely that such is the case.

This white clay marl, the building stones occurring in the northern portion of the formation, the potter's clays above referred to, and a pure white and exceedingly refractory, semi-indurate white pipe-clay, occurring near the edge of the Vicksburg rocks in Catahoula parish, constitute the practically useful materials of this group in Louisiana; where on the whole, it yields much fewer waters impregnated with noxious salts, than is the case in Mississippi.‡

The Vicksburg group.—The territory underlaid by the rocks

* This Jour., Jan., 1867, p. 41.

† Probably the same as that which appears on Pearl river, in Marion Co., Miss., at "Barnes' White Bluff," and has been used as a fertilizer (Mississippi Report, 1860, p. 179).

‡ Ibid, p. 187, et al.

of this division of the Eocene Tertiary, forms a band about thirty miles wide, crossing the state in a W.S.W. direction, north of the Grand Gulf group.

The features of the Vicksburg group, where it is crossed by the Washita, seem to agree closely with those given in my general section (p. 140 of the Mississippi Report of 1860). According to the observations of my companion, Dr. Walker (who determined the line between this and the Grand Gulf group, on the Washita), lumps of Orbitoides limestone at the foot of the Grand Gulf sandstone ridges, are the first evidence of the change of formation. Thence northward, lignito-gypseous clays are reported for some distance, while about six miles below Columbia, according to information from residents, there are limestone hills with small shell prairies and marl beds.

Northward of Columbia, calcareous strata corresponding to the Jackson group do not seem to occur on the Washita until we reach "about fifty miles (by water) south of Monroe," the locality from which Dr. Harlan obtained the vertebræ of Zeuglodon described by him in 1832.* Thus far, the section of the marine Tertiary on the Washita corresponds very well to that on Yazoo and Pearl rivers, in Mississippi; only the intervening lignitic stratum, which forms the base of the Vicksburg bluff, is more extensively developed on the first mentioned stream.

On the Sabine river, too, the upper portion of the profile is pretty correctly reproduced. At the base of the Grand Gulf rocks we find, on the bayou Taureau, a seam of shell limestone with Vicksburg fossils. We then pass over lignito-gypseous strata to Sabine Town, Texas, where we see about seventy feet of these, overlying ledges of blue fossiliferous limestone alternating every two or three feet with what would be greensand marl like that of Vicksburg, had not the lime of the numerous shells of which it contains casts, been removed by subsequent dissolution. So far as I have seen, the usual leading fossils of Vicksburg are wanting here; while the greater sandiness of the materials, as well as the prevalence of shallow-sea bivalves, indicates their deposition in shallower water. As we proceed northward from Sabine Town, lignitic clays and lignite alone separate, and sometimes altogether replace, the limestone ledges, which themselves become poorer in fossils, as we approach the northern edge of the formation.

Beyond, we again enter upon lignitic territory, which thenceforth continues with unbroken uniformity, so far as the Tertiary is concerned, to the Arkansas line.

* Trans. Am. Phil. Soc., vol. iv, N. S.

From my own observations farther east, as well as from information obtained from others, it seems that there is a gradual increase of the lignitic clay facies in the Vicksburg strata, as we advance westward from the Washita. The Casatche Hills below Natchitoches are described as consisting of alternating limestone and marl strata, capped by Orange Sand knolls; while the "Grande Ecore" on Red river, a few miles above Natchitoches, exhibits only dark laminated clay and sand. In the flat region between Dugdemona and Red rivers, where I recrossed the Vicksburg territory, there is but little chance for observation; but about the middle of the belt, on the heads of Bear creek, semi-indurate marls with *Orbitoides*, *Pecten Poulsoni* and *Ostrea Vicksburgensis*, are abundant; as well as farther east, the nodular Orbitoides limestone, at the base of the Grand Gulf rocks.

The Mansfield group.—In Mississippi the stages of the marine Tertiary are separated by lignitic clay strata; in Alabama, on the contrary, they are directly superimposed upon each other.* The lignitic bands gradually increase in thickness as we advance westward, but the territory underlaid by them in Mississippi is generally too limited, and the development of the strata too slight, to necessitate their designation by a special name. At Vicksburg, nevertheless, the thickness of the lignitiferous stratum intervening between the Vicksburg and Jackson groups, is not less than 35 to 40 feet, and it underlies a district several miles in width, on the Yazoo bluff.

In western Louisiana, as already stated, none but lignitiferous strata of Tertiary age, occur north of the Vicksburg group, as far north as Shreveport, and so far as I have been able to ascertain, up to the Arkansas line. In fact, the only locality in Louisiana known to me as distinctly of Jackson age, is that already mentioned as the source of Zeuglodon bones, described by Dr. Harlan, about half way between Columbia and Monroe, on the Washita. Nor does the main body of the marine Tertiary seem to extend any farther west in Arkansas, the outcrops mentioned by Dr. Owen being chiefly on Washita and Sabine rivers, in about the same longitude; to the westward of which excepting an outlier of Tertiary limestone in Clark county, the Tertiary epoch seems to be, in both states, represented by lignitiferous, fresh or brackish-water deposits. Nevertheless, the characteristic marine fossils of the Jackson group, according to Buckley† occur abundantly in (southeastern ?) Texas.

Very probably, the equivalents *in time* of all the marine groups exist in the lignitic Tertiary of Arkansas, Louisiana

* This Journal, Jan., 1867, p. 30.

† Prelim. Report on the Texas Geol. Survey, 1866, p. 44.

and Mississippi, their change of character denoting a change in the depth (and consequently in the character) of the waters in which they were deposited. It will be extremely difficult to define the portions corresponding to each of the various marine epochs; meanwhile, I propose to designate as the *Mansfield group*, that portion which, from its geographical position and general uniformity of materials, seems to be the equivalent of the lower portion of the Vicksburg bluff. It is very characteristically developed near Mansfield, La., and there presents a feature foreign to the other lignitic groups I have investigated, viz: a ledge, ¾ to 2 feet thick, of an impure, laminated limestone with numerous, but mostly fragmentary, impressions of lignitized stems and leaves. A narrow (¼ to ½ in. wide) band of this rock seems to extend from Mansfield as far as Shreveport, appearing mostly a few feet below the hilltops. Bluish-gray, clayey sands and mouse-colored laminated clays are the predominant materials, with which lignite beds are frequently associated; and near these, well preserved impressions of leaves are not uncommonly found. The surface of the territory occupied by this group is undulating, sometimes (on the rivers) hilly; and as usual, the higher ridges are everywhere capped by the Orange Sand, whose ferruginous solutions have frequently metamorphosed the subjacent Tertiary material into ferruginous shale or sandstone; at the same time forming above the line of contact large deposits of concretionary Brown iron ore,* containing from 40 to 60 per cent of hydrous peroxyd, which will doubtless in time become of considerable practical importance.

Numerous and extensive lignite beds exist in northern Louisiana, the economical importance of which is already beginning to be appreciated.

The limestones of the Vicksburg group at many points yield excellent lime, while the more impure varieties possess in the large amount of glauconite they contain, special advantages for agricultural purposes. Good marls of various kinds also abound. These calcareous materials are the more important in an agricultural point of view, because the soils of the territory, both of the Vicksburg and Mansfield groups have in general a foundation of pretty stiff red clay, derived from the lignitic clays, upon which stimulation produces a great and lasting effect. This red subsoil may almost be considered characteristic of the uplands of northern Louisiana; which are very far from being "Pine Woods," in the sense in which the expression is understood east of the Mississippi; especially where the Vicksburg rocks underlie.

* Mississippi Report, 1860, pp. 23, 24.

The Cretaceous outliers, presently to be mentioned, furnish limestone containing only 1 to 1·5 per cent of impurities, and are sometimes chemically pure carbonate.

The Salines of North Louisiana.—One of the most striking features of North Louisiana is the occurrence of salt springs and licks, usually accompanied by outcrops of limestone, which appear sporadically, but usually near the water courses, mainly near the head of Lake Bisteneau and on the waters of Saline bayou, in the parishes of Bossier, Bienville and Winn.

Brines of considerable strength and purity are obtained in these licks by sinking shallow wells or pits, usually to the depth of 14 to 20 feet. Sometimes brine is obtained in sand, without striking any rock; most frequently, a bed of limestone is encountered, sometimes compact, more frequently coarsely and incoherently crystalline, consisting of more or less horizontal bands or aggregates of white, yellow or black calcareous spar. Beneath this rock, of a few feet thickness, a bed of white or gray granular gypsum of 12 to 20 inches thickness, frequently appears, and beneath this the brine is reached, in a sandy layer.

At several points deep borings have been made in these licks, from 200 to as many as 1,100 feet, whereby an increased and, in some cases, an artesian supply of brine has been obtained. The precise records of these borings have been lost; but in one case at least the pile of borings, in others tradition, testifies that calcareous or gypseous materials were met with all the way. This fact coupled with the lithological character of the latter (which is foreign to all the Tertiary groups known to me), and a "find" of several individuals of *Exogyra costata* and *Gryphœa Pitcheri* in the rubbish of one pit, suggests that we have here, not local Tertiary basins, but rather the peaks of a Cretaceous ridge, projecting through the lignitic Tertiary; whose lithological characters agree closely with those described by Dr. Owen as characterizing a portion of the Cretaceous of Arkansas, and equally corresponding to those observed on the upper Red River, near Fort Washita, by Dr. G. G. Shumard.*

The highly crystalline, non-fossiliferous, horizontally banded limestone which characterizes most of these saline outliers, reappears independently farther south, in the shape of limestone ridges elevated perhaps a hundred feet above the drainage of the country; as near Winfield, and on Saline Bayou below Drake's Salt Works.

It will be observed that the general trend of the body of these outliers is about S.E. and N.W. A continuation of this line strikes the main body of the Cretaceous of Arkansas, in Hempstead county, on the one hand; on the other, a body of

* Marcy's Exploration of Red river, p. 195.

limestone of precisely similar character, near Chicotville in St. Landry parish, La., on the territory of the Grand Gulf group, which in the absence of other evidence, I had previously referred to the latter (see above). Its absolute lithological identity with the limestones of Northern Louisiana, as well as the incongruity with all other materials heretofore observed in the Grand Gulf or other Tertiary deposits, leave little room for doubt that here, within 70 miles of the Gulf coast, we have another Cretaceous summit rising out of the Tertiary. And if we follow still farther the general line of trend, southeastward, we light upon the group of Five Islands, and notably the rock-salt deposit of Petite Anse.

It is perhaps too early to discuss the question, whether the latter coincidence is accidental, or whether this ancient Cretaceous ridge thus forming the "backbone" of Louisiana, has caused, not only the shallowing of the older Eocene sea into marshes and lagoons, but also the eastward deflection of the lower Mississippi, and explains the simultaneous existence of salt both in North and South Louisiana. If rock-salt, however, should be found to form any part of the Cretaceous rocks of the southwest, a Cretaceous outlier at Petite Anse would be scarcely more strange than the limestone outcrop near Chicotville. The presumption is still farther strengthened by the phenomena observed in the wells bored near the West Fork of Calcasieu river, about twelve miles west of Lake Charles in Calcasieu parish.

The Artesian wells of Calcasieu.—These are located on two small islands in the (fresh-water) marsh which forms the head of bayou Choupique, a small tributary of the main Calcasieu river. It was long known that on one of these islands there existed "tar springs" which had formed an asphaltum pavement on a portion of the surface, and continually evolved combustible gas; and not long after the close of the war, boring operations were commenced there by the "Louisiana Petroleum and Coal Oil Co.," whose auger had, at the time of my visit, reached a depth of 1,230 feet.

Another bore has been commenced on an island about 700 yards to the westward; the work, now carried on by Dr. Kirkman of Lake Charles, has reached a depth of 450 feet. The following is a comparative profile of both wells.

The data for the following profile are derived, for position and thickness, from the statements of the well-borers; the materials are given from samples of the borings picked from the pile by them in my presence, and I have every reason to think that the facts are faithfully represented.

As regards the interpretation of the formations penetrated,

Profile of Artesian Wells, west fork of Calcasieu river.

Kirkman's Well.			Louisiana Oil Co.'s Well.			Formations.
Depth.	Thickness.	Materials.	Depth.	Thickness.	Materials.	
Ft.	Ft.		Ft.	Ft.		
		Blue and yellow clay, with some sand strata.		160	Blue clay, sometimes with layers of sand soaked with petroleum.	Port Hudson Group.
	354		160			
				173	Loose sand and gravel, 138 to 153 ft. very pebbly; 153 to 173 ft. finer material.	Orange Sand Group.
			333			
			343	10	Gray laminated clay ("soapstone").	Vicksburg Group.
		Sand with clay laminæ, 36 ft.		40	Blue, sandy, nodular limestone, with marine shells. Petroleum and gas.	
	96	Sand and gravel, 56 ft.	383			
				60	Soft, white, crystalline, crumbling limestone; tube driven through.	Cretaceous Formation.
450	-----	Sandy pipeclay, 4 ft.	443			
				100	Pure crystalline sulphur.	
			543			
				147	Sulphur and gypsum, alternating. About ½ sulphur. 5 ft. Sulphur bed at 650 ft. 10–15 " " 680 "	
			690			
				540	Pure gypsum. Dense, granular, and coarsely crystalline, grayish or white.	

there can of course be no doubt as to the identity of the Port Hudson and Orange Sand groups. It is interesting to note, that here as elsewhere the Orange Sand rests on a deeply denuded surface, and has itself suffered subsequent denudation; as is evidenced by its relative levels in the two bores. The pebbles are of the usual character; chiefly chert and siliceous sandstones, still showing impressions of palæozoic fossils; the largest observed weigh about five ounces.

While Kirkman's well has chanced upon a valley of denudation, the Company's well has struck a ridge whose summit has resisted denudation by the aid of a cap of hard clay shale, in which, besides, there was a layer of sandstone. As soon as this was penetrated there was a violent rush of combustible gas, and water mixed with petroleum. The amount of the latter however, never exceeded a few barrels a day, even when the pump was used; and great difficulty was experienced in pene-

trating the stratum of loosely piled, disjointed, rounded lumps of blue limestone, which kept tumbling in from the sides. This is evidently the oil-bearing stratum, and (reports to the contrary notwithstanding) I am satisfied that no fresh supply of oil was found after reaching the underlying white limestone.

The rare shells contained in the blue rock are too ill-preserved to allow of specific determinations; but their very state of preservation, no less than the peculiar lithological character of the rock, suggests at once the correspondence to the base of the Sabine Town bluff; which is, moreover, corroborated by the comparative chemical and microscopic analysis. The lignitic nature of the intervening beds, as well as the occurrence of asphalt in the Vicksburg limestone of Mississippi, are suggestive with reference to the oil-bearing feature. The overlying clay stratum likewise coincides.

As to the underlying white limestone, it is a material utterly foreign to any of the Tertiary groups of the Southwest, while coinciding precisely with some of the limestone of the saliferous cretaceous outliers of North Louisiana; here again, chemical as well as microscopic characters coincide as strikingly as they differ from those of the blue oil-bearing rock.

For the immense *sulphur bed* underlying, we have no direct precedent, unless it be the occurrence of a sulphur-bearing earth in the gypsum formation on Delaware creek, on the southern border of the Llano Estacado, observed by Capt. Pope.* But the interstratification of sulphur and gypsum in the lower bed proves the closeness of their mutual relation, while the enormous thickness of the underlying gypsum bed recalls at once the great gypsum formation of the upper Red river, and the Llano Estacado; faintly represented by the gypsum beds of North Louisiana, and Arkansas.

The age of the great gypsum formation has been the subject of much discussion. It has always seemed to me that the great extent of the area over which the Cretaceous beds and underlying gypsum are known to be coëxtensive, went far to prove that they belonged substantially to the same epoch. Whatever weight may attach to this argument is greatly enhanced when we find the crystalline limestone and underlying gypsum not only reappearing in northern Louisiana, but actually accompanying each other beneath the waters of the Gulf of Mexico. Whether the volcanic agencies which even now so frequently disturb that great basin, have been instrumental in reducing the sulphur, distilling the petroleum, and crystallizing the rock salt of southern Louisiana, may be more profitably discussed

* Report of an exploration of a route for the Pacific railroad, near 32d parallel; Geology, by W. P. Blake, p. 38.

when more extensive excavations shall have given us an opportunity of closer inspection of the facts. As regards the sulphur bed, it seems strange that no such opportunity is as yet foreshadowed in the near future; although in my view, its practical importance can hardly be over-estimated. Its development requires, it is true, large capital and the best of engineering resources, in view of the depth, and peculiar difficulties of drainage and ventilation. But who that knows the part sulphuric acid plays in modern civilization, the monopoly enjoyed by Sicilian sulphur, the burdens naturally and artificially imposed upon its production in that island, and the inferiority of the acid prepared from pyrites, can fail to appreciate the intrinsic importance of a bed of pure sulphur some 135 feet thick, lying at a depth less than half of that at which some coal mines are profitably worked in Pennsylvania; and within ten miles of ocean navigation! The very gangue of the mineral—gypsum—is of sufficient value in agriculture and the arts, to bear shipment for thousands of miles, within the country. Nor indeed, is it likely that beds *of such magnitude* should be confined to a limited area, and not be accessible at more advantageous locations.

As regards the prospect of obtaining petroleum in paying quantities, the inconsiderable thickness of the Vicksburg rocks, and the obvious fact that they are traversed by valleys of denudation, are very unfavorable omens.

The water now flows from the Company's well at the rate of 65 gallons per minute; rises 12 feet above the surface. It is a *saturated solution* of sulphuretted hydrogen, with a little gypsum and common salt. This stream flows chiefly from the surface of the sulphur bed. Boring operations at this well have been suspended, and a company is now being formed with a special view to mining the sulphur.

ART. XXXI.—*Contributions from the Laboratory of the Lehigh University.* No. 2.—*On certain compounds of Chromium with Iron;* by J. HAYNES H. CORBIN.

PERCY, in his work on iron and steel (p. 186), describes several crystalline compounds of chromium with iron prepared and analyzed by Mr. Smith under his direction.

These compounds contained respectively the chromium percentages of 4·24, 27·07, 54·63, and 76·58, corresponding to the formulæ $Fe_{19}Cr$, Fe_3Cr, $FeCr$ and $FeCr_3$. The experiments were performed in pursuance of the investigations of Berthier,

who found an alloy of the formula Fe_2Cr, containing 17 per cent of chromium, and another containing as much as 60 per cent of this element. Berthier, Faraday and Stodart observed that the addition of 1 per cent of chromium to steel communicated to this compound great hardness and the quality of acquiring a beautiful damask by the action of dilute acids.

Boussingault has lately published (Chem. News, vol. xvii, p. 267, Eng. ed.) the analysis of a chromiferous wrought iron from Central America, containing 1·95 per cent chromium and 4·40 of combined carbon, which he obtained by a new method proposed by himself, viz: dissolving the powdered iron in a solution of corrosive sublimate.

The American Tool Steel Company of Brooklyn has been engaged in preparing alloys of chromium with steel upon a manufacturing scale. They placed a number of specimens of the various compounds in the hands of Dr. Charles M. Wetherill of this University, under whose instruction I have made the following examination of certain of them in the laboratory of the Lehigh University.

The specimens analyzed consist of:

1. Chrome iron ore from the neighborhood of Baltimore.
2. A specimen of chromiferous cast iron obtained by the reduction of 1.
3. Turnings of No. 1 steel prepared by use of 2.

1. The chrome ore possessed the ordinary character of the mineral, and analyzed by the method of Dr. Genth, gave the following percentage result:

Silica	2·12
Chromic oxyd	40·79
Alumina	4·20
Ferrous oxyd	44·48
Manganous oxyd	trace
Lime	2·32
Magnesia	5·21
Phosphoric acid	trace
	99·12

2. The chromium cast iron is a very hard silver-white metal; apparently a mass of interlacing crystal needles. Hardness of feldspar, but very brittle and of density 7·25. It is attacked with great difficulty by the different acids and was brought into solution for analysis by fusion with potassic bisulphate. On attempting to decompose it by means of the battery, only a partial decomposition ensued; the skeleton of carbon which remained contained a good deal of undissolved and crystalline

metal. The process of Boussingault, already referred to, was used for the determination of the carbon. Although this process worked satisfactorily with Boussingault, whose compound contained a small percentage of chromium, it failed with me to fully decompose this specimen, which contains more than 26 per cent of that metal.

The carbon was weighed as $\mathfrak{C}\Theta_2$ in a potash bulb. The compound yielded by the analysis:

	1.	2.	3.
Iron	70·18*	70·12	70·23
Chromium	26·25	----	----
Aluminum	·26	---	----
Calcium	2·16	----	----
Magnesium	·58	----	----
Silicon	trace	----	----
Carbon	1·69	----	----
Phosphorus	none	----	----
Sulphur	none	----	----
	101·12		

By eliminating carbon and supposing the small percentage of other metals than iron and chromium to be replaced by iron, the analysis yields almost exactly the formula $\mathfrak{Fe}_5\mathfrak{Cr}_2$; which is intermediate between 2 and 3 of Smith's compounds alluded to in the beginning of this article. Since the proportion of carbon in white cast iron varies from 3·5 to 5·75 per cent, this specimen is peculiar in having a much lower percentage of that element.

3. The chrome steel is a compound possessing some peculiar properties, a marked one being that of assuming a highly crystalline structure and cracking badly when tempered at the usual heat for tempering steel; but at a low red heat, a product of very fine grain is the result. Another property is, that it may be submitted to considerable torsion without breaking. A bar twenty-four inches in length and one half inch square, was twisted while cold by two men at the end of a powerful lever two and one half feet in length, until the lever described three complete circles. The twisted bar was now bent in the shape of an ellipse until the ends touched: on examination no injury to the steel could be detected, as it appeared to possess the same properties after as before the operation. The steel is very hard. The hardness of a tempered specimen is equal to that of quartz, and that of an untempered specimen to that of feldspar. The density of the tempered specimen is 7·79 and that of the untempered one 7·8. The density of the latter,

* Mean of 2 and 3.

however, had been raised by its having been struck with a hammer. Its fracture is white, conchoidal, and very fine in structure. Like ordinary steel it is attacked readily by chlorhydric acid, evolving fetid hydrogen and forming an oily scum. On treating the polished steel, both tempered and untempered, with dilute and strong acids, no damask could be obtained.

The analysis gave:

	1.	2.
Iron	95·92	95·27
Chromium	1·66	2·22
Aluminum	2·38	1·69
Calcium	0·44	
Magnesium	0·12	
Silicon	0·12	
Carbon	0·98	
Phosphorus	trace	
Sulphur	trace	
	101·62	

The carbon was determined as in 2. In analysis 1 the iron, chromium and aluminum were determined from an aliquot part of the oxyds precipitated together, by the addition of ammonia; while in the second analysis the iron was separated as sulphid, the chromium and aluminum being held in solution by addition of tartaric acid to the alkaline solution. On comparing this specimen with one quoted by Berthier, (Percy, p. 187) containing about the same percentage of chromium, it is found that his specimen by treatment with dilute acid yielded a beautiful damask, while this does not; from which one would conclude that there is a more thorough incorporation of the chromium throughout the entire mass in this compound, brought about by the process of manufacture, than in Berthier's. This would lead to a more uniformly hard, and probably harder, steel, on account of there being no interstices between crystals of iron and chromium, which, together with the carbon produced the damask in Berthier's specimen. It would seem that the properties of this steel are not due to the replacement of carbon by chromium as is thought by the manufacturers; for although the presence of the chromium may greatly tend to enhance the value of this compound as a steel, yet we find its content of carbon to be within the limits for producing a good quality of steel.

The extraordinary properties possessed by the chromium steel, may, in a great measure, be attributed to the uniform distribution of a hard uncrystalline alloy of iron and chromium through the mass of steel—so homogeneous, in fact, does this compound appear to be, that there is no veined structure or

damask to be noticed when treated with dilute acid. The almost total absence of the deteriorating elements, phosphorus, sulphur and silicon, has probably much to do with the quality of this steel; for the manner in which it may be twisted when cold, and heated to whiteness without "burning," forged and welded, presents an anomaly in the behavior of steel.

ART. XXXII.—*Contributions from the Laboratory of the Lehigh University.* No. II.—*Examination of a supposed Hercynite*; by CLARENCE A. WOLLE.

THE mineral Hercynite is known only by an analysis of Quadrat (Ann. Ch. Pharm., lv, 357.) A mineral very much resembling it was discovered by Prof. W. T. Rœpper, who kindly gave me the specimen for the following investigation, which was made in the Laboratory of the Lehigh University under the direction of Dr. Chas. M. Wetherill. The locality is near Peekskill, N. Y., and Prof. Rœpper, who visited the spot, describes the mineral as occurring in large isolated masses in syenitic gneiss.

The supposed hercynite is intimately mixed with magnetite, from which it may be freed by digesting the fine powder with hydrochloric acid. It remains unaltered by this reaction and appears, under the microscope, as a transparent greenish crystalline mineral which, when fused with carbonate of soda, is not decomposed. The crystals were boiled with a solution of carbonate of soda to remove silica.

The mineral thus treated when examined under the microscope shows traces of octahedral cleavage and crystallization. It is vitreous on surfaces of fracture, but otherwise possesses a dull luster. The color is greenish to leek-green, becoming greener and lighter when powdered; to the naked eye it is not transparent. Hardness 7·5; specific gravity 3·58; not magnetic.

Before the blowpipe it shows the following reactions:—1. Alone infusible. 2. With carbonate of soda bead it remains undissolved and floats about like silica in a microcosmic salt bead, and on withdrawing from the flame is first green and finally on cooling turns gray. 3. With borax bead, a yellow-green glass, which on cooling assumes on olive-green color. 4. With microcosmic salt, dissolves completely, and forms a greenish-yellow glass, which, when cold, is colorless.

The qualitative analysis shows Al_2O_3, Fe_2O_3 and MgO to be its constituents. 0·8036 gram of the dried substance was taken, according to Rose and Quadrat, and fused with about five to six times its weight of bisulphate of potassa in a platinum crucible

for a considerable time, thereby evolving SO_2. After a perfect fusion the mass when cold was dissolved in water made slightly acid with HCl, and from this solution the Al_2O_3 and Fe_2O_3 precipitated with NH_4O and finally separated by KO, and treated as usual. The Fe_2O_3 after being incinerated weighed ·2364 gram, =29·40 per cent, and the Al_2O_3 weighed ·4885 gram, =60·79 per cent.

The MgO in the filtrate from the first precipitate of Al_2O_3 and Fe_2O_3 was precipitated as phosphate with phosphate of soda, and weighed, after incineration, ·2863 grm. =·1032 grm. MgO =12·84 per cent. The results of the analysis therefore yield—

Fe_2O_3	=	29·40 per cent.
MgO	=	12·84 "
Al_2O_3	=	60·79 "
		103·03

The iron does not all exist as FeO, for such constitution would give the oxygen ratio of $RO : R_2O_3$ as 1 : 2·557 instead of 1 : 3. The hardness and insolubility in acids of this mineral show that it is a spinel. Part of the Fe must therefore exist as Fe_2O_3. A calculation of this Fe_2O_3 in such a manner as would give the oxygen ratio 1 : 3 will yield the following percentage composition:

$\dot{A}l$	$\dot{F}e$	$\dot{F}e$	$\dot{M}g$	
60·79	5·26	21·74	12.84	= 100·63

and calculating from the formula—

$$(\tfrac{1}{4}\dot{M}g + \tfrac{1}{4}\dot{F}e) +)\tfrac{1}{2}\tfrac{9}{0}\dot{A}l + \tfrac{1}{2}\tfrac{1}{0}\dot{F}e),$$

we obtain the following percentage composition, which agrees well with the above analysis:

$\dot{A}l$	$\dot{F}e$	$\dot{F}e$	$\dot{M}g$	
60·45	4·94	22·25	12·36	= 100

An analysis of a spinel from Tunaberg, by Erdman, gave the following results:—

$\dot{M}g$ 13·03 $\dot{F}e$ 23·46 $\dot{A}l$ 62·95 = 99·44.

From the above analyses and remarks, it will therefore be seen that the mineral is a magnesia-iron spinel, with part of the the Al_2O_3 replaced by Fe_2O_3, and it may be regarded as intermediate between Hercynite and Ceylonite.

Sept. 1869.

ART. XXXIII.—*Contributions from the Laboratory of the Sheffield Scientific School, Yale College.* No. XXII.—*On the proximate Composition of several varieties of American Maize;** by W. O. ATWATER, Ph.D.

THE four varieties of Indian corn analyzed are as follows:

A. *Early Dutton Corn.*—An early variety, yellow in color, twelve rowed, kernels rather small. Ears medium size. One of the most common varieties of early corn in New England.

B. *The common Yellow Corn* of New England and the eastern States, also called *Canada Corn.*—Eight rowed, kernels and ears of good size.

C. *King Philip Corn*, sometimes called *Rhode Island Corn.*—Brown-red color, eight rowed, ears and kernels often quite large.

D. *Stowell's Evergreen Sweet Corn.*—Specimens are sold under this name, having twelve and sixteen rows, ears short and thick.

Preparation for analysis.—The corn was ground in an ordinary drug-mill. The mill was carefully cleaned by grinding corn therein until the meal came through clean in appearance. For the ash-determinations, a portion of each sort was coarsely crushed in the mill. Another portion was then ground quite fine for the other investigations, in which the result could not be appreciably affected by an amount of impurity from the mill, not detectable by the eye. Considerable care was taken to insure a thorough mixture of the material, it having been noticed on cleaning the mill before the grinding of each specimen that a portion of the finely divided substance adhered to the interior, which portion it was feared might come from the softer and more easily pulverized part of the kernels. In a number of cases it was found necessary to grind the meal still finer with sand in a porcelain mortar. The specimens for analysis were all ground at the same time, and set aside for use in well closed bottles.

Determination of water.—The accurate estimation of hygroscopic water is often attended with difficulties, owing to the extreme slowness with which the last traces of water disappear, as well as to the fact that, from long continued heating there results an oxydation of fatty matters and an alteration and loss of other elements.

At the suggestion of Prof. Johnson, use has been made of the Bunsen pump, and the following method adopted, by which the above difficulties have been obviated, to a great extent. One or two grams of the very finely divided material are weighed off, and quickly transferred to a dry round-bottomed

* Graduating Thesis presented to the Faculty of Philosophy and the Arts, Yale College, July, 1869.

glass flask, of about 75 c. c. capacity. The flask is then closed with a perforated rubber stopper, which has been previously boiled in caustic soda, and is itself closed with a glass rod. This is allowed to stand in the balance for a time, and is then weighed with a similar flask as counterpoise. The stopper is then removed and the flask is partially immersed in boiling water and allowed to remain for an hour. The stopper is now inserted, the glass rod being replaced by a glass tube, bent at right angles, which connects with the Bunsen pump. The exhaustion by means of the latter is made as complete as possible, and the boiling continued for half an hour or an hour. With the proper precautions, an hour's boiling with the flask open, and the same under exhaustion, suffice to bring the flask and its contents to a constant weight.

During the last boiling, moisture is apt to condense in the tube. I have found it well to expel this by heat, or still better, to replace the wet tube with a dry one. A tube, with the horizontal arm 20 cm. long, answers well for this purpose. It is of course essential that the interior of the pump be as dry as possible, otherwise a number of hours may be required for the completion of the process.

After the drying is finished, the tube is removed from the stopper, the glass rod inserted, and the flask set aside in the balance for half an hour or more. The rod is then removed, for a moment, to allow access of air to the interior, and again inserted, when the whole is weighed. The difference of the two weighings is the loss of water. The results accord closely as seen from the subjoined figures.

Water per cent.

A.		B.		C.		D.	
I.	II.	I.	II.	I.	II.	I.	II.
8·09	8·08	10·54	10·51	9·78	9·80	10·75	10·98

A, had been kept for some months in a very dry atmosphere. The others were in the same hygroscopic condition as when taken from the seed-store.

Determination of Ash.—For this purpose two methods have been employed. In each, two, or more generally, three grams of meal were used. By the first, the meal was ignited for from twelve to twenty hours at a low heat in a porcelain capsule over a Bunsen lamp. By this means the corn was without difficulty burned to a light gray or nearly pure white ash. The difference between the weights of the light gray and of the white ash is quite inconsiderable—two trials giving less than half a milligram each.

By the second method the meal was charred, first at a quite low, and then at a somewhat higher heat, for a little time after all empyreumatic odors had disappeared. It was then boiled with water and filtered. The filtrate was evaporated to dry-

ness, and gently ignited, while the filter with its contents was incinerated at a much higher heat, and the residue weighed with that of the filtrate.

I append results of experiments by the two methods.

A 1. 2d method, per cent,	1·52	Soluble, 1·04 Insoluble, ·48
A 2. " " " "	1·52	Soluble, 1·03 Insoluble, ·49
A 3, 1st " " "	1·56	
A average of four others,	1·52	
B 1. 2d method, per cent,	1·31	Soluble, ·80 Insoluble, ·51
B 2. " " " "	1·30	Soluble, 1·01 Insoluble, ·29
B 3. 1st " " "	1·30	
B 4. " " " "	1·36	

As intimated above, the amount of carbon left unconsumed in direct incineration, with a low and long continued heat, is very trifling; and the comparative results above given confirm the observation of Strecker, that there is no loss of alkali-chlorids in this process.* The ash thus obtained is free from carbonic acid. The amounts of soluble and insoluble ash correspond very closely with the amounts of soluble and insoluble ingredients, as calculated from the average of the best analyses.

Here follow the ash-determinations made in case of A and B by the second method above described, and in case of C and D by the first.

Ash, per cent.

A.		B.		C.		D.	
I.	II.	I.	II.	I.	II.	I.	II.
1·52	1·52	1·31	1·30	1·61	1·58	1·87	1·91

Determination of Fat, &c.†—This substance was estimated by the use of Storch's apparatus,‡ which has proved to be very convenient. The ground corn was triturated with pure quartz sand previous to extraction. Pure ether was the solvent used. Corks, if employed for connectors, need to be purified by pre-

* Compare Fres. Quant. Anal. on preparation of ash of plants for analysis. Also Ann. d. Chem. u. Pharm., lxxiii, 366–8.

† According to Hoppe Seyler, (Med. Chem. Unters., i, 162), a sample of maize examined by him, yielded

Ether-extract	3·770 per cent, which contained
Cholesterin	0·100
Protagon	0·149
Saponifiable fat and yellow pigment	3·521

‡ A modification of the "Extracteur" of Payen; Fres. Zeitsch. f. Analyt. Chem. 1868. S. 68. I have found that a glass tube 13 cm. long, 3 cm. wide at the upper, and 2 cm. at the lower end, answers quite well, especially if the taper be confined to the lower 4 cm.

liminary treatment. Ordinary cotton batting will also need purification. A portion of that which I used, when dried at 100° C. and treated with ether, gave 0·9 per cent of a fatty substance, which on cooling had the appearance of tallow or stearine. Great care and considerable time are required to remove the last traces of ether and moisture from the fat and the flask containing it, before weighing. I have always used, in weighing, a counterpoise flask similar to the one in which the fat was collected. Below are my results:

Fat, per cent.

A.		B.		C.		D.	
I.	II.	I.	II.	I.	II.	I.	II.
5·76	5·58	4·42	4·41	4·52	4·38	7·57	7·75

L. Lenz (Henneberg's Jahresbericht, 1866–7, p. 151), has published examinations of six varieties of maize, in which he finds a small proportion of fat in the endosperm and a large percentage in the chit (*keime*), and expresses the opinion that the fat found in the endosperm really belonged to portions of the chit which escaped separation. To test this supposition, I have made the following experiment:

A number of kernels of common yellow corn, B, were taken, the interior soft portion of each kernel carefully cut and scraped out, and the two portions weighed.

Weight of outer hard portion, endosperm,	30·211 grm.	76·43
" " inner soft " embryo with some endosperm,	9·321 grm.	23·57
Total,	39·532 grm.	100·00

The former portion was ground and the amount of water and fat determined as above, with the following result:

Water,	15·92 per cent.
Fat,	1·37 " "

Lenz found in the endosperm of the maize examined by him from 0·75 to 1·96 per cent of fat, the mean of his six results was 1·32 per cent. The water-content of the endosperm he analyzed was less than the above, viz: from 9 to 10 per cent. The larger percentage of moisture in my sample was due to the fact that the corn had been standing for some time, and was likewise ground in a very damp air. It appears then that while the endosperm is very much poorer in fat than the chit, it is nevertheless not entirely free from this material. The ether-extract from the endosperm had much the same appearance as that from the entire kernel obtained in the ordinary estimations.

Determination of Albuminoids.—The amount of nitrogen*

* The nitrogen determinations gave the following figures:

A.		B.		C.		D.	
I.	II.	I.	II.	I.	II.	I.	II.
1·53	1·54	1·56	1·55	1·88	1·92	1·76	1·79

was estimated by combustion with soda lime, and the result, multiplied by 6·25, was taken for the amount of albuminoids.*

Here follow the results:

Albuminoids, per cent.

A.		B.		C.		D.	
I.	II.	I.	II.	I.	II.	I.	II.
9·56	9·62	9·75	9·69	11·75	12·00	11·00	11·19

Determination of Cellulose.—The cellulose was estimated by alternate extraction with diluted acid and alkali (Peligot's method), after Henneberg's directions, (Versuchs-stationen, vi, 497). As is well known, the methods for cellulose estimation are not entirely accurate, and the results here given are probably somewhat too low.

Crude fiber ash-free, per cent.

A.	B.	C.	D.
I.	I.	I.	I.
2·52	2·40	2·21	2·63

Another trial, no doubt less accurate, from the fact that the material was allowed to stand for some time in the liquid previous to each decantation, gave

A.	B.	C.
II.	II.	II.
1·69	1·60	1·76

And a trial upon the material left from an unsatisfactory attempt to estimate starch, by Dragendorff's method, described in Johnson's "How Crops Grow," p. 66, gave after extracting starch with dilute chlorhydric acid—

Crude fiber ash-free.

B.	C.	D.
1·03	1·34	1·78

Determination of Aqueous Extract, Gum and Sugar.—Four grams of finely ground material were treated with cold water in a beaker for two hours, and then filtered with the aid of the Bunsen pump. The whole operation required three or four hours for completion. In the case of the sweet corn it was found necessary to make the solution of known bulk, and take aliquot parts of the first portion of the filtrate for the estimations, as the filter became, after a time, so clogged as to forbid the passage of the solution, even when under pressure. The filtrate was divided into four equal portions, each representing

* The mean factor 6·25 is that adopted by the *Versuchs-stationen* of Germany. The recent investigations of Ritthausen, Jour. f. Prakt. Chem., cvi, p. 483, give in maize-fibrin 15·58 per cent of nitrogen. Stepf, (same Journal, 76, 90), found 15·6 per cent of nitrogen. The other albuminoid in maize is very near Ritthausen's *Conglutin*, and contains 17·72 per cent of nitrogen, but as it forms but 0·5 per cent of the grain, (*loc. cit.*) we must conclude that 6·4=(100÷15·6) is the proper factor for calculating the albuminoids. This gives the following average percentages:

A.	B.	C.	D.
9·82	9·95	12·16	11·36

one gram of meal. The first portion was evaporated to dryness in a platinum capsule, weighed, ignited, weighed again, and the difference reckoned as aqueous extract, ash-free. From the last weight was subtracted the weight of the capsule and the difference was reckoned as ash. The results are as follows:

	A.	B.	C.	D.
Aq. ext. ash-free,	7·22	7·14	7·85	16·28
Ash,	·74	·88	·68	·97
Total aq. ext.	7·96	8·02	8·53	17·25

When examined qualitatively, the extract gave with iodine a blue tint, indicative of the presence of a small amount of starch, and when ignited in a glass tube with soda-lime, yielded a slight reaction for ammonia, showing that there was a small amount of albuminoid matters likewise present.

In every instance the solution was somewhat turbid, from presence of a trace of suspended fat (?) This was especially true in case of the sweet corn. On boiling, a white substance, probably a coagulated albuminoid, separated from the solution. The quantity was however very small, and its estimation was not attempted. Stepf gives the amount of albumin in the maize he examined at 0·62 per cent.

The researches of von Bibra* indicate the absence of dextrin from the cereal grains, a conclusion which is quite in accordance with my own qualitative examinations. I have therefore considered the aqueous extract to consist of sugar and gum exclusively, so far as its non-nitrogenous ingredients are concerned.

The second portion of the aqueous solution was also evaporated to dryness at near 100° C., treated with alcohol of 66 per per cent, filtered, the filtrate evaporated to dryness, and the residue treated as before. The following results were obtained:

	A.	B.	C.	D.
Dissolved in alcohol,	6·95	7·20	5·53	11·53
Undissolved,	0·27	0·00	2·32	4·75

It is probable that the alcohol of 66 per cent carried gum into solution. In B the albuminoid was also dissolved.

More confidence is to be placed in the results obtained with the third portion of the aqueous extract, by the use of Fehling's solution, as described in Fresenius' Quantitative Analysis. The precipitated suboxyd of copper was collected on weighed filters, and the sugar was reckoned as glucose. I obtained:—

	Sugar and Gum, per cent.			
	A. II.	B. II.	C. II.	D. II.
Sugar,	3·00	4·78	3·05	11·64
Gum, by difference,	4·22	2·36	4·80	4·64

Want of time cut short my work at this point, and I regard these determinations of sugar and gum as open to revision.

* Die Getreidearten und das Brod, *passim.*

The complete (mean) analyses stand as follows, taking the sugar and gum as estimated with Fehling's solution and reckoning starch by difference:—

	A. Early Dutton.	B. Common Yellow.	C. King Philip.	D. Stowell's Evergreen Sweet.
Water,	8·08	10·52	9·79	10·86
Albuminoids,	9·62	9·72	11·87	11·10
Sugar,	3·00	4·78	3·05	11·64
Gum,	4·22	2·36	4·80	4·64
Starch,	65·40	64·49	62·23	49·58
Fat,	5·67	4·42	4·45	7·66
Cellulose,	2·52	2·40	2·21	2·63
Ash,	1·52	1·31	1·60	1·89
	100·00	100·00	100·00	100·00

Subjoined are the mean percentages of the proximate elements calculated upon dry substance:

	A.	B.	C.	D.
Albuminoids,	10·46	10·86	13·16	12·45
Sugar,	3·26	5·34	3·38	13·06
Gum,	4·59	2·64	5·32	5·21
Starch,	71·13	72·08	68·99	55·62
Fat,	6·16	4·94	4·93	8·59
Cellulose,	2·74	2·68	2·45	2·95
Ash,	1·66	1·46	1·77	2·12
	100·00	100·00	100·00	100·00

In these analyses the percentage of water and ash alone can be regarded as quite correct. The percentage of albuminoids must be considered as a close approximation to the truth. The figures given for "sugar" and "gum" (aqueous extract) are likewise probably not far from right. They include, however, a little of some soluble albuminoid and possibly soluble starch —the "amiduline" of F. Schulze and "amylogen" of Jessen. The cellulose is much lower than most chemists have found. Thus Poggiale, Payen and Polsen obtained respectively 4·5, 9 and 14·9 to 20·4 per cent of fiber. That these figures are erroneous must be concluded from simple ocular investigation. Fresenius, using Peligot's method obtained 1·58 per cent. Bibra rejects Peligot's method as yielding too little cellulose, but the numerous analyses executed by the German Agricultural Chemists within recent years indicate that its results do not vary widely from the truth. The error in the percentage of starch (insoluble), which is determined by difference, cannot probably exceed 2 or 3 per cent.

The only detailed investigations upon Indian corn by American chemists with which I am acquainted, are those of J. H.

Salisbury, Trans. N. Y. State Ag. Soc., 1848, p. 678, and those of C. T. Jackson, U. S. Patent Office Report, 1857, p. 160, and Geology of New Hampshire, pp. 256 *et seq.* These investigations, the former of which, especially, was quite extended, were unfortunately made for the most part by methods too imperfect to yield valuable results. I append an analysis by Salisbury, above report, p. 779, of "Yellow Corn," the same variety as B of the present article, also one of "Rhode Island Sweet Corn," same report, p. 784.

	Yellow Corn.	R. I. Sweet Corn.
Water,	11·18	10·22
Albumen,	6·46	13·00
Casein,	·12	2·64
Zein or gluten,	7·32	3·68
Sugar and extract,	11·87	18·08
Sugar,	·65	2·72
Dextrin or gum,	6·28	12·32
Starch,	42·03	15·16
Oil,	4·35	9·92
Fiber,	9·36	12·80
Matter separated from fiber by weak solution of potash,	·44	·24
Ash,	not given	not given
	100·06	100·78

The following is an analysis by Jackson, Patent Office Report, 1857, p. 161, of King Philip Corn.

Water,	10·0
Gluten or zein,	5·0
Casein and albumen,	2·0
Dextrine and glucose,	1·5
Starch,	54·5
Fat oil,	4·2
Cellulose,	17·3
Undetermined, ash, &c.,	2·0
	100·00

As seen above, Dr. Salisbury found in Sweet Corn 12·32 per cent of dextrin or gum and 13·00 per cent of albumen, and in the article referred to attributes the shrivelling of the kernels to the loss of water in the drying of these bodies. It cannot be doubted that the estimations were erroneous.

In "The Geology of New Hampshire," page 259, Dr. Jackson reports the amount of oil in different varieties of corn as varying from 6 to 11 per cent, the latter amount being found in the Canada Corn (B of this paper). In the same article, p. 257, he states that the oil in this variety as in several others, is con-

fined chiefly to the endosperm, whereas Lenz and myself find it nearly all in the chit. On page 258 Dr. Jackson "is able to prove that the popping of corn" is due entirely to the decomposition of the oil and the formation of carburetted hydrogen gas. But it is a matter of experience that sweet corn which is remarkable for its large content of oil, expands only very slightly in "popping." On page 257, Dr. Jackson mentions "a beautiful and new application of chemistry" by which the use of qualitative tests, "iodine," "sulphate of ammonia," &c., "we may easily cause any grain to point out the extent and precise limits of each of its ingredients and by the eye we can form a pretty correct estimate of their relative proportions in different seeds." It would be ungracious to notice these statements, were it not that they are frequently quoted as a part of our standard knowledge on this subject.

It will be seen from my analyses that the three first varieties of corn which are quite similar in general appearance and in the consistency and structure of the kernel, are almost identical in composition, while the sweet corn is much poorer in starch and richer in sugar and gum as well as in fat. I hope to have an opportunity in the future of extending my investigations in this direction so as to accomplish more perfect separations and also to examine a large number of varieties of American maize.

ART. XXXIV.—*On the Magnetite in the mica of Pennsbury, Pa., in reply to Prof. G. Rose;* by JAMES D. DANA and GEORGE J. BRUSH.

1. *Note by J. D. Dana.*

PROFESSOR ROSE, of Berlin, in a paper published in the Proceedings of the Royal Academy at Berlin (Monatsberichte für 1869, p. 339), has pronounced the statement in my Mineralogy (p. 150), that the markings in the Pennsbury mica are due to thin films of magnetite, an error, and has instead called the mineral *hematite*. The first reference of the species to magnetite was made by Prof. Brush, and I therefore leave it to him to mention the observations upon which the conclusion was based. They afford full proof, I feel assured, that the mineral is not hematite, and make it scarcely less certain that it is magnetite.

Professor Rose's arguments are mostly opinions rather than facts or demonstrations. He *infers* from his having seen very minute grains of magnetite, even those obtained in blowpipe reductions, which were not transparent, that the excessively thin transparent crystalline films in the mica are not magnetite.

He infers, from his having observed scales and markings of hematite in *some* micas, that those of the mica in question are probably hematite. Finkener having, at Professor Rose's request, examined the Pennsbury mineral and found in it protoxyd of iron, he infers that this protoxyd is an accidental ingredient, as is true in the case of some hematites, and not evidence that the species is magnetite. Rammelsberg thinking he has reason to believe that the oxyd of iron coloring green bottle glass is magnetite, the inference is drawn that magnetite if transparent would be green, and hence the mineral by its brownish shades shows that it is not magnetite. Such evidence has not great scientific value.

The seemingly decisive fact brought forward, to which the above inferences are added, relates to the color of the mineral. In my Mineralogy the films are said to vary from "colorless to pale smoky brown and black." Professor Rose states that, besides having these colors, it is also sometimes *red* and *yellow*. This was, from the first, observed to be true by Professor Brush and myself. But it was further seen by us that *the red and yellow colors were always a result of alteration;* and we are sure that if Professor Rose had examined the hundreds of specimens that have been at our disposal, he would not have failed to detect this. He argues from the occasional red color which he observed that the mineral is not magnetite, but hematite; when in fact the range of colors from colorless to black proves just the reverse, or at least that the species is *not* hematite.

In applying the term *dendrite* to these markings I had reference to the *dendritic forms* they generally present, and not to the time or mode of origin, on which latter point I held the same view with that sustained by Professor Rose.

2. *Note by G. J. Brush.*

The following are the observations which led me to believe that the mineral imbedded in the Pennsbury mica in dendritic forms is magnetite, and which force me still to the same conclusion contrary to the opinion of Professor Rose.

1. From an examination of several hundred specimens it appeared that the mineral was black and opaque where sufficiently thick; that this color shaded into dark brown; and this faded gradually into a delicate smoky hue, still retaining the brown color, becoming finally almost colorless.

2. Wherever the mineral had been exposed to alteration, especially toward the edges of the crystals of mica, it was *sometimes* changed to a bright red or yellow color. A large number of specimens, however, showed no evidence of alteration.

3. I found that the mineral was powerfully magnetic, so much so, that a thin film would rise to the magnet, carrying with it a load of mica many times its weight. I also found that *where the film of mineral was red or yellow it was destitute of magnetic properties.*

4. I determined by blowpipe tests that the mineral was an oxyd of iron yielding no reaction for titanium.

5. On heating the blackish brown mineral to redness out of contact of air it retained its color, but heated with access of air it became red. I also found that when the yellow mineral was heated it became red.

From these observations I concluded that the *yellow* mineral was hydrated oxyd of iron; that the *red* substance was sesquioxyd of iron (hematite); and that the *mineral varying from colorless to smoky and blackish-brown* was magnetic oxyd of iron, or in other words *magnetite*; and further, that wherever the specimens were red this was due to oxydation, and the consequent formation of hematite; and where they were yellow it was due to hydration as well as oxydation.

I have made a careful reëxamination of a large number of specimens and have not only confirmed my former observations but have found that the red mineral when rubbed on white porcelain gives a red streak, the yellow mineral an ochre yellow streak, while the blackish brown mineral gives a black streak. This is additional evidence that the red mineral is hematite, the yellow mineral hydrated oxyd of iron, and that the magnetic mineral is in all probability *magnetite.*

ART. XXXV.—*On the probable origin of Albertite and allied minerals;* by S. F. PECKHAM.

IN a paper read at the meeting of the National Academy of Science last August,* I expressed the opinion, that solid bitumens occurring in veins of large extent, of which the Albertite is an example, had not been formed by the inspissation of petroleum, but were the product of a very gradual distillation of bituminous minerals at a minimum temperature resulting from their metamorphosis. In the same paper I showed that petroleums containing paraffine and very little nitrogen, like those of Pennsylvania, were not rendered more dense by oxydation, but by inspissation.

In 1863 Mr. J. P. Lesley expressed the opinion in reference to Grahamite, that, "there seems to be no escape from the conclusion, that the substance filling the vertical vein is a pro-

* Proc. Am. Phil. Soc., x, 457.

duct of the gradual oxydation of coal-oil once filling the open fissure," and further, that "it is not impossible that the lower regions of the fissure are still filled with liquid oil."*

In 1865 in a report made upon Grahamite, Prof. Henry Wurtz states, that the general aspect of the mass, as well as all the results of a minute examination of the accompanying phenomena, lead irresistibly to the conclusion that we have here a fissure filled by an exudation, in a pasty condition, of a resinoid substance derived from, or formed by some metamorphosis of unknown fossil matter, contained in deep seated strata intersected by the fissure or dike."†

In 1865 Prof. Charles H. Hitchcock, State Geologist of Maine, said, "The Albert Coal" (Albertite) "was originally in a liquid state, was injected into vertical fissures, and subsequently hardened into a substance resembling jet."‡

The same year Prof. Hind, of New Brunswick, endeavors to show that Albertite is an inspissated or hardened petroleum."§

In 1868 Prof. Wurtz says, "no doubt can now be held, that the Albertite vein was formed by the injection of a fluid or pasty mass of matter into a fissure or crack in the rocks; that is, in the same way that a dike of volcanic trap or lava is formed."‖

In the recent edition of his System of Mineralogy (1868) Prof. Dana says, "Grahamite occurs in West Virginia, * * filling a fissure (shrinkage fissure), * * and supposed to be like the Albertite, an oxygenated petroleum."

At the time I ventured the opinion that Albertite was not an inspissated petroleum, I had not seen Prof. Wurtz's papers. His views, however, do not appear to be endorsed by Prof. Dana, who refers to these papers and then states the opinion held by a majority of observers, viz: that the minerals are inspissated or oxygenated petroleums. I propose to examine the testimony of those who have written upon this subject, and note some of the difficulties which appear in the acceptance of such a theory.

It appears to me that all true veins of bitumen occurring in the older strata of West Virginia, New York, Canada and New Brunswick may be referred to a common origin. The asphaltum veins of Cuba may or may not be more nearly allied to a hitherto undescribed vein, occurring upon the coast of

* Ibid, ix, 183.

† Rep. on a mineral formation in W. Va. by Prof. Henry Wurtz, to the Ritchie Mineral Resin and Oil Co., Baltimore, Md.

‡ This Journal, II, xxxix, 272.

§ Prelim. Rep. on the Geology of New Brunswick, chap. v.

‖ Coal or Asphalt, an inquiry into the proper classification of the Albertite of New Brunswick.

Southern California, of which I shall speak hereafter. To this also, without doubt, are more nearly allied certain veins said to occur in Miocene sandstones near the junction of the White and Green rivers, Colorado.*

All observers agree that the veins first mentioned are true cutting veins, at, or nearly at, right angles to the planes of the strata which they intersect. In most instances the enclosing rocks present evidences of metamorphosis, in others they are unaltered, and in others still the metamorphosis has obliterated the planes of stratification, the rocks becoming crystalline. It is further their unanimous opinion that the mass was injected, and from below upward; also that the mass was in either a fluid or semi-fluid condition. Prof. Hitchcock believes that the Albertite has been injected at two distinct periods. He also describes "horses" or enclosed pieces of the wall rock, as common in the vein. Prof. Wurtz describes one of these masses as occurring in the Grahamite, but a few feet below the cavity from which it fell. The vein of Albertite has been mined to the depth of a thousand feet without diminishing in thickness; it forms the crown of an anticlinal, the walls pressing against it with sufficient force to granulate the mineral, and crush large sticks of timber as they close behind the miners. In all these veins the lines of demarcation between the "veins" and "country" are clearly drawn, there being no intervening mass of rock more or less completely saturated with bitumen.†

The thickening of *petroleum* to a solid mass, by either evaporation or oxydation, or both combined, is an exceedingly slow process. Even in California, where the change takes place most rapidly, months if not years are required to cause the oil to become asphaltum, even when it is spread out in a thin pellicle and exposed freely to the atmosphere and an unclouded sun. Neither Grahamite nor Albertite could have been derived from oil like those of California, becoming dense from decomposition, as they both yield paraffine, but must have been derived, if derived from petroleum at all, from the more stable class represented by those of Pennsylvania which thicken by evaporation, or from an oil partaking of the characters of those of both regions.

Let the prior existence of a subterranean pool of petroleum be admitted. The fissure is formed and the oil enters it. In the case of the Albertite, what held the walls asunder while the oxydation was in process of completion—a process which

* Annual of Scientific Discovery, 1866–7, p. 257. Proc. Bos. Soc. Nat. Hist., 1866. At the recent meeting of the American Association, Prof. Wurtz stated that the Colorado bitumens resembled Albertite; they are not therefore allied to the California asphalts.

† For authorities, see papers before quoted.

after a solid pellicle was once formed would go on more and more slowly as it proceeded downward? What held the masses of wall rock suspended but a few feet below the cavity from which they fell, while the oxydation was in process? What has become of the remainder of which these enormous masses are *only the residue?*

Is the hypothesis of their derivation from petroleum more acceptable, if it be admitted that the substance entered the fissure in a semi-solid condition? The fissure opened and was filled. The filling could not be gradual by infiltration, else the same questions arise respecting the wall rock and the "horses." The oxydation must then have been completed at a depth of more than a thousand feet below the surface. Through what agency could the oxydation have been effected at that depth? In California, petroleums were found changed by oxydation at a depth of nearly five hundred feet; the change however was only slight; they were still *fluids*. The strata too, in that region are very much broken and porous, wherever the oils are oxydized beneath the surface. If the veins were filled by a residue from the evaporation of petroleum, the evaporation must have taken place at a great depth by internal heat—certainly not by the sun's rays. What then became of the lighter portion, amounting to from ninety to ninety-five per cent? Did the formation contain fissures into which the vapors arose and were condensed? If such is the case why is not Hillsborough Co., New Brunswick, one of the richest petroleum regions in the world? Is it probable that so vast a quantity would have escaped so as to leave only traces at present? In Canada and New York such veins are remote from springs of petroleum, and are usually, if not always, found in metamorphic strata.

This hypothesis presupposes a subterranean sea of petroleum. The quantity must have been vast or the fissure could not have been at once filled with the residue. Its accumulation must have been finished before the distillation began, as it could not have been fed from above downward, as hydrostatic pressure constantly forces oil toward the surface; neither could it have been fed laterally for the same reason; nor could it have been fed from beneath, unless we suppose the mass to represent one product in a system of fractional condensation. Distillation commences; if the cavity were hermetically sealed, enormous pressure is generated, and a corresponding increase of temperature required for further distillation. The pressure increases until the crust of the earth is ruptured, and from ninety to ninety-five per cent escapes as vapor, leaving a perfectly homogeneous mass which is forced by the collapse into the fissure,

and solidifies on cooling. If the cavity were not sealed, and the temperature gradually decreased toward the surface, fractional condensation in the crevices of the rocks must be the result, the heavier portions succeeding the lighter as the descent was made. This latter supposition makes no provision for the ruptured crust and filling of the fissure, nor for the absence of petroleum in the immediate vicinity, of every degree of density.

The first hypothesis—that the veins were ever filled with liquid petroleum—appears to me to be impossible; the second—that they were filled with the material in its present form, a residue from the distillation of petroleum—may be possible but not probable.

The hypothesis first announced by Prof. Wurtz, is at every step in strict conformity with well-known facts, and it is surprising that it should have escaped the attention of geologists and chemists for so long a time. It is remarkable, that Prof. Lesley should have cited the fact that quartz veins cut injected veins of bitumen in the state of New York, as proof of the aqueous origin of the quartz, and not have ascribed the origin of the bitumen to the same cause, acting upon different materials.* Mr. Vanuxem thus speaks of these minerals: "The anthracite of this rock, from its appearance in the form of drops or buttons, and as before noticed, proves that its previous nature was bituminous, its own being infusible; and shows the heat not dry but humid, to which the greater part of the rock had been subjected, and which readily accounts for the numerous siliceous and other products which are common to it."†

It is a fact well known to technologists in coal-oil, that the lower the temperature at which coals or shales are distilled, and the more slowly the process is conducted, the more dense and copious will be the product. So far is an excess of heat to be avoided, that the most improved methods reject the upright retorts which necessitate sufficient pressure to throw the vapors into the worm, and apply the heat at the upper surface with a downward draft, by which the products of combustion are made to pass through the mass to be distilled, and bear away all the volatile products at the lowest possible temperature. Also when the substance to be distilled melts at a temperature below the point at which distillation commences, the use of superheated steam not only increases the quantity of the distillate but also its density. This fact is proved most conclusively, by a comparison of the results first obtained in the manufacture of Albertite itself, with the results of the latest and most improved process.

* Loc. cit. (note.)

† Geology of New York, Pt. III, by L. Vanuxem, p. 34.

It only becomes necessary, therefore, to subject pyroschists like the Albert shales, rich in bituminous matter, to metamorphic action through the agency of aqueous vapor, and the distillation of the volatile matter at the lowest possible temperature becomes a necessity. As time always enters as an element into the operations of nature in sufficient quantity, all the conditions would be present requisite to the production of the most copious and dense distillate which such materials were capable of furnishing. It is impossible to conceive of the metamorphosis of such rocks, containing large cavities in comparatively free communication with the surface, without producing such a result. Without such free communication, pressure and consequently a higher temperature would produce more or less volatile liquids and naphtha springs would be the result. Humboldt speaks of having observed metamorphic rocks near Cumana containing bitumen, and not far distant he also saw naphtha floating upon the sea, into which streams of hot water were injected from subterranean springs, in such quantity as to raise its temperature preceptibly.* In one of the recent numbers of this Journal, the results are given of an analysis of a specimen of mica schist from Sweden containing bitumen.† According to Dr. Taylor the rocks enclosing the asphaltum veins in Cuba are metamorphic slate. The Albert shales forming the wall-rock of the vein of Albertite are metamorphosed. The rocks in which veins of bitumen occur in New York and Canada are metamorphic, in many instances having been subjected to a secondary action, which has rendered the rocks crystalline, and expelled nearly all of the volatile matter, leaving but little more than coke, resembling anthracite.‡ Quartz veins have cut the vein of bitumen during this secondary action. Masses of melted bitumen, have formed the nucleus around which quartz or calcite began to crystallize, and afterward in cooling hardened in botryoidal masses upon the crystals. In a few instances minute drops or irregular fragments, became entangled in the crystals themselves. The idea that petroleum has been inspissated from the center of a geode of quartz, or from an hermitically sealed cavity of calcareous rock, is opposed to all that is known in reference to that substance. The bitumen had ceased to be petroleum before the rocks enclosing it assumed their present form. If the Albert shales were subjected to such action as would render them crystalline, it is probable that all the phenomena witnessed in New York and Canada, would there be observed on a gigantic scale. The fact that the rocks enclosing the Grahamite are

* Travels, i, 198; iii, 113, Bohn's ed.
† This Jour. (II), xlv, 38.
‡ Vanuxem; T. S. Hunt, Geol. Surv. Canada, 1866, p. 262.

unaltered, is no proof that they are unaltered at the point at which the bitumen originated.

Prof. Wurtz mentions two facts as observed in connection with the Grahmite, which renders the supposition impossible, that the fissure was ever filled with a liquid. They are, first, the occurrence of "horses," and second, the fact that the porous wall-rock of sandstone is not penetrated by the bitumen. The occurence of "horses" is equally conclusive proof that the injection did not take place into a previously formed fissure. The determination of the cause which produced the fissure is not essential: its *position* in reference to the subterranean pool of melted bitumen was no doubt determined by the pressure exerted by compressed gaseous hydrocarbons, which accompanied the melted mass. The injection was no doubt caused by the collapse of the subterranean chamber, and partial expulsion of its contents.

The occurrence of asphaltum at La Goleta, (Hill's Ranch) a few miles west of Santa Barbara on the coast of Southern California, is noticed by Prof. Whitney. The wood cuts which accompany this notice, however, are on too limited a scale, to convey an adequate impression of the position and relation of the different masses to each other.*

An injected vein of asphaltic sand occurs here, which appears to the eye to be pure asphaltum, but it really contains nearly fifty per cent of sand. It bears no resemblance to Albertite in its appearance, composition, or in its probable origin. The *injection* of the vein, however, no doubt took place in a manner strictly analogous to the *injection* of the Albertite. The mass of the former is very small in comparison to that of the latter, and this fact, together with the limited area over which the forces have been exerted, renders a study of the phenomena much more exhaustive and satisfactory.

The vein occurs in a slight indentation of the coast, caused by the wearing down of a bluff between two rocky promontories. The bluff at this point is about sixty feet in height above high water, the sand of the shelving beach beneath it, covering the upturned edges of the oil shales, but a few feet in depth. Irregular masses of asphaltum protrude above the water for some distance from the shore, and several irregular veins, some in an horizontal as well as perpendicular position, project from the bluff with here and there lenticular masses of small extent. From the masses last mentioned a sort of talus decends, connecting them with the shales below. The largest vein stands perpendicularly and at right angles with the face of the bluff. It cuts the bluff from the base to the summit, and is wedge-

* Rep. Geol. Surv. Cal., Geol. I, 132.

shaped, thinning out from two and a half feet in thickness at the bottom to six inches at the top.

The bluff is composed of semi-indurated Post-pliocene sandstone. The strata are so slightly curved as to appear horizontal for short distances. A recent deposit a few feet in th ickness forms the soil of the plain above. These sandstones rest unconformably upon the edges of the oil shales, which are inclined at an angle of seventy or eighty degrees. From a careful study of the positions of the several masses, it is evident, that since the several veins were filled, not only has the sea advanced a long distance inland, but the entire coast line at this point, has experienced a very considerable elevation. Within the memory of those now living in the vicinity, the bluff extended a considerable distance beyond its present verge, the erosion taking place as marked by the uncovering of the large vein, at the rate of about two and one half feet per year. The elevation of the coast line at a recent geological date, is proved by the presence, a short distance farther west, of old beach lines nearly on a level with the present summit of the bluff. On the borders of this ancient beach irregular masses of asphaltic sand are found, mingled with the shells of bivalves, now found off the same coast. The occurrence of these masses indicates that the springs which yield the maltha, which has been observed floating on the sea in this vicinity for the last hundred years, projected their product into the sea at the time when this beach was at the sea level. The maltha now, as then, becomes dense upon exposure, and is cast upon the beach, where it is rolled and mixed with the sand and gravel until it becomes hard asphaltic sand.

It is evident that this maltha at one time arose and saturated the overlying sand, instead of being projected into the sea. The exact method by which this saturation took place is perhaps beyond conjecture, but the inference that it took place beneath the superincumbent mass which then formed the bluff, cannot be avoided. It is equally obvious that the asphaltic mass entered the fissures in a pasty condition; and also that it entered from beneath. The effects of the disturbance which produced the injection, could not at the time of my visit, be traced below the Post-pliocene formation. This disturbance seemed to have proceeded from a focus about a quarter of a mile from the present beach, and to have lifted and torn asunder the more recent deposit of sixty feet in thickness, which, falling back upon the yielding mass of asphaltum, caught and held a large portion of it in its fissures.

While the matter in which the mass of bitumen collected has not necessarily any direct bearing upon the question of its subsequent injection, the subject is still of much interest.

Twenty-five miles east of this point, upon the coast, an equally interesting and unusual deposit of asphaltic sand occurs. In this instance, the sand is spread out horizontally over a very wide area (many hundreds of acres), and uniformly, about twenty feet in thicknes, so far as is known. This stratum of asphaltic sand lies uncomformably upon the upturned edges of the oil shales, from which the tarry maltha exudes and gradually saturates the sand. Judging from a section of both shales and sand, which appears for nearly a mile along the coast, the saturating process is still in progress.

We have only to suppose this process to take place beneath sixty feet of semi-indurated sandstone, instead of ten feet of sand and soil, and we have the action which preceded the injection of the vein just described. Again, we have only to imagine a metamorphosis of deep-seated bituminous strata, producing a distillate a thousand or more feet beneath Silurian or Devonian rocks, which gathered in their crevices, and we can readily account for the gathering of the mass of Grahamite or Albertite previous to injection. An earthquake, shrinkage, or the expansive force of pent up gasses, may have caused an upheaval and fracture of the superincumbent mass. It makes no difference whether the fractured mass were a thousand, five hundred, sixty or ten feet in thickness, in either case when it fell, it would force a part of the plastic mass into the fissures and hold it there.

At this time only specific names have been given to those bituminous minerals occurring in veins, which are evidently derived from the metamorphosis of bituminous strata. They possess many properties in common, and are essentially unlike the true asphalts, which are derived from petroleum. I think it was Dr. Taylor, of Philadelphia, who several years since proposed the name of "Meta-Asphalt" as a generic name for minerals of this class.

Washington and Jefferson College, Washington, Pa., July 6th, 1869.

ART. XXXVI.—*On a new method of observing contacts at the Sun's limb, and other spectroscopic observations during the recent Eclipse;* by Prof. C. A. YOUNG, of Dartmouth College.

OUR party was one of those organized, and subsidized by Prof. J. H. C. Coffin, Superintendent of the Nautical Almanac; and the one which was so fortunate as to enjoy his personal presence and supervision.

Our station was at Burlington, Iowa, a few miles north of the central line, where the duration of the totality was 2 minutes and 50 seconds. The air was perfectly clear, without cloud or haze; the thermometer during the Eclipse ranged from 76° to 67°, and the barometer from $30^m{\cdot}140$ to $30^m{\cdot}065$. The wind was from the N.W., but very gentle.

The spectroscopic combination employed, was compiled for the occasion from various instruments belonging to Dartmouth College, and differed so much in the relative proportion and arrangement of its parts from those hitherto used, that a brief description is perhaps neccessary.

The telescope which formed the solar image was a comet-seeker by Merz & Son, of 4 inches aperture and 30 inches focal length. An ordinary Huyghenian eye-piece enlarged the image so that when it fell upon the slit of the spectroscope at a distance of 5 inches, it was $2\frac{1}{8}$ inches in diameter. The use of an eye-piece gave an easy means for securing the accurate focus of the limb at the slit, an adjustment of great importance. The spectroscope proper had telescopes of $2\frac{1}{4}$ inches aperture and $16\frac{1}{2}$ focal length (by Alvan Clark). The eye telescope was provided with an eye-piece magnifying 18 times, and a wire micrometer, constructed from a reading microscope, for determining the position of any new lines in the spectrum by referring them to those already known. This, although a very accurate method, was too slow to be well adapted to eclipse observations, but was the only arrangement I could construct with the time and means at my command.

The collimator had a slit $\frac{1}{8}$ of an inch long and of adjustable width. It was provided with a small prism, which could be turned up so as to throw into half the slit light from an electric spark formed between platinum electrodes by a small induction coil and Leyden jar.

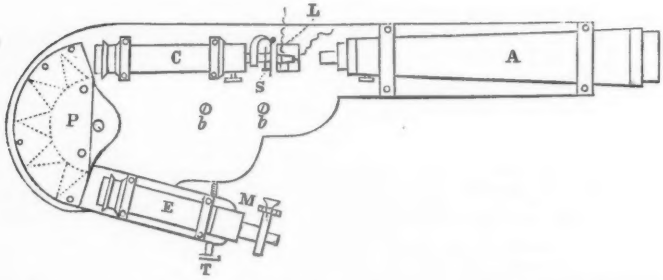
It also carried a thin brass disc about $2\frac{1}{4}$ inches in diameter, placed in front of the slit, with a hole of $\frac{1}{8}$ of an inch in the center. This disc was covered with white paper and graduated into sectors of 10° by lines radiating from the center. This graduated screen, upon which the image of the sun was clearly visible even during the totality, answered the purpose of a finder, and its graduation furnished the means of determining within less than 3° the position of any object observed on the sun's limb, or of bringing any desired portion of the limb to the slit.

The spectrum was formed by a train of 5 prisms of 45° each, with faces $2\frac{1}{4}$ by $3\frac{1}{4}$ inches. They gave a dispersion of about 18° between A and H, with a total deviation of about 165° for the D line. The box which contained them was so connected

by a link with the arm which carried the eye-telescope, that whenever the latter was moved by its tangent-screw along the spectrum the prism box would turn through an angle just half as great. Thus the prisms were kept in the position of best definition for whatever lines were in the middle of the field of view, the extent of which was sufficient to embrace D and E together.

The telescope and spectroscope proper were firmly secured to a wooden framework, and this was mounted equatorially, with slow motion screws in both right ascension and declination. Fig. 1 gives an idea of the appearance of the whole.

1.



A, Comet-seeker; C, collimator of spectroscope; L, camera lucida prism, and platinum electrodes; S, graduated disc immediately in front of slit; P, prism box; E, eye telescope; T, tangent screw for moving telescope across the spectrum; M, micrometer; b, b′, bolts securing the frame-work to the equatorial mounting.

The spectrum was about $1\frac{3}{4}$ inches broad (referred to a distance of 10 inches) and about 45 long. It showed all the lines on Kirchhoff's maps of the spectrum; such lines as the nickel line between D_1 and D_2 being perfectly distinct.

I had seen with the instrument before the eclipse the following six bright lines at the sun's limb, viz: C, 1017·5 K. (near D); 1474 K. (near E); F; 2796 K. (near G); and *h*: on two occasions also I had seen a 7th line at* or near 660 K. a little below C. The line 1474 K. was discovered by me on the 9th of July, and I do not *know* that it was seen by any one else before the eclipse, though quite possibly it is the new line reported by Rayet on the 7th of June, the position of which I have never seen stated. P. S. It was discovered by Lockyer on June 6th.

The scale of my instrument was referred to that of Kirchhoff by repeated and closely accordant measures of 42 intervals be-

* Possibly this may be the 'fainter red flash' already described by Mr. Lockyer, to which Lieut. Herschel alludes in a letter to Mr. Huggins published in the Sept. number of the Chemical News, page 152, American edition. I have not yet seen Mr. Lockyer's notice.

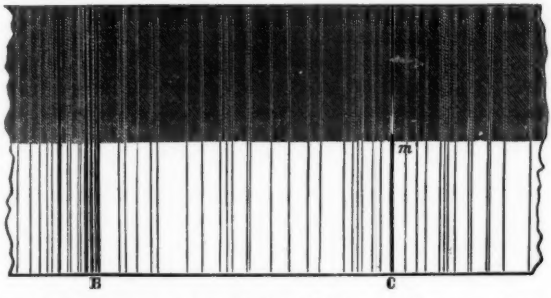
tween important lines, covering the whole length of the spectrum from A to G. Above G, Angström's map was made the basis.

In order to observe the first contact I had provided myself with a solar eye-piece which could be used upon the comet-seeker without disturbing the spectroscope; but about half an hour before the totality the idea presented itself that a more accurate result could be obtained by means of the spectroscope than in any other way—thus:

Suppose that by means of the tangent screws and the position lines on the screen-disc, that part of the sun's limb at which the contact is to take place is brought across the center of the slit and kept there by the slow motion.

Under ordinary circumstances, if the eye-telescope is directed upon the C line, the appearance will be what I have roughly represented in fig. 2. The spectrum will be divided

2.



into two portions by a longitudinal line of demarcation. One half of it, formed by the disc of the sun itself, will be intensely bright; the other half formed mainly by the illuminated air near the sun's limb, comparatively dark. Most of the spectral lines will extend across both portions alike; not so the C line. *A brilliant needle of scarlet light* projects into the dusky spectrum from the end of the *dark line* in the bright portion of the spectrum (at the point marked *m*,) formed by the light from the hydrogen in the solar chromosphere. The length of this needle in my instrument usually ranges from $\frac{1}{8}$ to $\frac{1}{4}$ of an inch, even when the slit is not near any prominence. (The whole width of the spectrum, $1\frac{3}{4}$ inches, was found, with the eye-piece used on the comet-seeker, equivalent to 1′ 55″ of arc, whence the thickness of the chromosphere is easily deduced; it seems to vary from 3000 to 8000 miles commonly).

Now it is evident that as the moon approaches the sun she must first eclipse this chromosphere, and the observer can de-

termine the instant of contact by noticing the extinction of the bright needle.

Similar remarks apply to F, or any other line of the chromosphere spectrum, but C is incomparably the best to observe.

Having arranged my instrument therefore, with the computed point of contact across the center of the slit, I had the unspeakable gratification of seeing everything take place as expected. First, a full half minute before the time of contact, the sharp point of the needle was truncated by the dark edge of the moon, then it grew steadily shorter, (not *less brilliant* what remained of it) until finally its last spark vanished, the C line became exactly like its neighbors, and the contact was effected.

The observation was as easy and definite as that of the transit of a moderately slow star, β Ursæ Minoris for instance. I am confident the observation may be relied upon within a fraction of a second, although it was from 5 to 15 seconds earlier than the time assigned by any of the other observers. I am informed by Professor Mayer, however, who had charge of the photographic operations of our party that it agrees within one third of a second with the time deduced from a preliminary measurement of a photograph taken about 15 seconds after the contact was announced.

With an instrument of sufficient dispersive power, the slit might be opened somewhat widely, and placed *tangent* to the sun's limb. In this case a slight error in the estimated point of contact would not interfere with the accuracy of the observation.

I wish to call attention to the applicability of this method at the coming transits of Venus. It is not possible, perhaps, to predict just how great will be the effect of her atmosphere ; but it is difficult to see in what respects this method will suffer from it more than any other. It certainly presents this great advantage, that the observer will perceive and watch the planet's approach long before the instant to be observed, and thus have all the benefit of preparation.

It seems likely also that the instant of *internal contact* will be more easily seized with the spectroscope than with any other instrument. Instead of the rupture of a black ligament, it ought to show the sudden formation of a brilliant line running the whole length of a before dusky spectrum, a phenomenon much more striking than the other.

While the moon was advancing upon the sun, special attention was paid to the appearance of the spectrum lines near her limb. They came up to the edge perfectly square and straight, even when the limb made an angle of only 5° or 6° with the

slit; and the longitudinal line of demarcation, before referred to, between the brilliant and dusky portions of the spectrum was hard and sharp, in striking contrast with the effect of the sun's limb, which under similar circumstances always gives a boundary more or less hazy and indefinite, and this to a degree continually changing from minute to minute. This contrast was beautifully exhibited a few seconds before the totality when the limbs of both sun and moon were on the spectrum together, the width of the visible portion of the sun having become less than the length of the slit. It was at first thought that this appearance was decisive against the existence of a lunar atmosphere however rare: but a little consideration shows that on the other hand it is, if anything, favorable, being a simple consequence of that brightening of the sun's disc near the moon's limb, which is so beautifully evident upon the photographs; and which is most easily accounted for by admitting a slight refraction suffered by that portion of the sunlight which grazes the moon. Possibly, however, it may yet be explained as a case of simple inflection of light.

Before the eclipse began, the existence of prominences on the limb of the sun had been ascertained in the following positions, (reckoning from the north point through the east). A large but faint one near $+90°$, a small but bright one at $+146°$ (the photographs show *two* here), a long low one at $-70°$, very near the point of first contact, and an enormous and very bright one at $-130°$, with several others of small elevation but considerable length on different parts of the limb.

At the beginning of the totality the slit was upon the prominences at $+146°$; the eye telescope upon C. As soon as totality commenced this line blazed out magnificently, but from the small extent of the prominence did not reach across the spectrum. No line appeared below C, nor any between C and D. The orange line, which for convenience I will call D_3, (1017.5 K) was beautifully bright, but no longer than C. Between it and the next prominent line were two faint lines, situated by estimation at 1250 ± 20 and 1350 ± 20 of Kirchhoff's scale. Then came the 1474 K line, which was very bright, though by no means equal to C and D_3; but attention was immediately arrested by the fact that, unlike them, it extended clear across the spectrum, and on moving the slit away from the protuberance it persisted, while D_3, visible in the edge of the field, disappeared. Thus it was evident that* *this line belonged, not to the spectrum of the protuberance, but to that of the corona.*

* On two or three occasions previously I had been very much surprised at not being able to detect this line in the spectrum of unusually bright prominences. On the other hand I once found it very easy to see at a place on the sun's limb where the other chromosphere lines, usually far more brilliant, were almost invisible.

My impression, but I do not feel at all sure of it, is that the two faint lines between it and D_3, behaved in the same manner, and are also corona lines.*

I may as well confess that my uncertain memory here is due to the fact that just at this time, while my assistant was handing me the lantern with which to read the micrometer head, I looked over my shoulder for an instant, and beheld the most beautiful and impressive spectacle upon which my eyes have ever rested. It could not have been for five seconds, but the effect was so overwhelming as to drive away all certain recollection of what I had just seen. What I have recorded I recall from my notes taken down by my assistant.

By this time the moon had advanced so far that it became necessary to shift the slit to the great prominence on the opposite side of the sun. While my assistant was doing this I suppose I must, in the excitement of the moment, have run my eyepiece over the region of the magnesium lines (*b*), and thrown them out of the field before he had brought any thing upon the slit. At any rate I saw nothing of these lines, which were evident enough to several other observers, and can think of no other way to account for their having escaped me.

The F line in the spectrum of the great protuberance was absolutely glorious, broad at the base and tapering upward, *crookedly*, as Lockyer has before often observed. Next appeared a new line,† about as bright as 1474, at 2602±2 of Kirchhoff's scale. Its position was carefully determined by micrometrical reference to the next line, 2796 K (Hydrogen γ) which was very bright—*h* was also seen, very clear but hardly brilliant. In all I saw 9 bright lines.

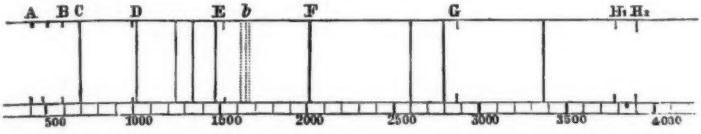
A faint continuous spectrum, without any traces of dark

* A careful examination of the photographs, especially No. 2 of the Burlington totality pictures, somewhat diminishes my confidence in the conclusion of the text as to the nature of these three lines (1250, 1350 and 1474). They certainly do not belong to the spectrum of the *most brilliant portion* of the prominences; but around the prominences of the eastern limb, on which the slit of the spectroscope was directed during the first half of the totality, the photograph shows a pretty extensive and well defined nebulosity, evidently distinct from, though associated with, the brilliant nuclei. Now it is *possible* that these lines may belong to this nebulosity, and not to the corona proper; for I cannot recall with certainty whether 1474 retained its brilliance at any considerable distance from the prominences or only in their immediate neighborhood. My strong impression however is that the former was the case, and that the text is correct. I am confirmed in this opinion by Professor Pickering's observation. He used a single-prism spectroscope, with the slit of the collimator simply directed to the sun, and having no lens in front of it. With this arrangement he saw only 3 or 4 bright lines, *the brightest near E* (1474) Now this is exactly what ought to occur, if that line really belongs to the corona, which, from its great extent, furnished to his instrument a far greater quantity of light than the prominences.

† This is undoubtedly the line described by Lieut. Herschel as between F and G, in the letter referred to in a former note, Chem. News, Sept., 1869, p. 152, Am. Ed.

lines in it, was also visible, evidently due to the corona. Its light, tested by a tourmaline applied next the eye, proved to be very strongly polarized in a plane passing through the center of the sun. I am not sure, however, but that this polarization, as suggested by Prof. Pickering, may have been produced by the successive refractions through the prisms. This explanation at once removes the difficulty otherwise arising from the

3.



absence of dark lines. Figure 3 exhibits the position of the lines seen by me, and I have also added the magnesium lines.

My observations decide nothing as to specific differences between the different protuberances, since from the smallness of my field of view, I was obliged to observe a portion of the spectrum on one of the prominences and the rest on another.

I had just completed the measurement of 2602 when the totality ended. This line disappeared instantly, but 2796 was nearly a minute in resuming its usual faintness. I cannot describe the sensation of surprise and chagrin, of wasted opportunity, personal imbecility, and complete exhaustion which overwhelmed me when the sunlight burst out. Many other observers I believe shared in it.

Having for some time entertained the idea that there might possibly be some connection between the Aurora Borealis and the Solar Corona, immediately after the eclipse I examined Angström's map, in which he lays down one bright line in the Aurora spectrum. It plainly did not coincide with 1474. But on my return home I found in the July number of this Journal the positions of five lines observed by Professor Winlock in the spectrum of the Aurora. In numbers of Huggins's scale they are given as follows, viz: 1280 (brightest), 1400, 1550, 1680 and 2640. Now from the data given in Professor Gibbs's recent articles on 'wave lengths by the method of comparison,' we easily find, with a probable error of not more than 2 or 3 divisions, that H 1280 = K 1247; H 1400 = K 1351; and H 1550 = K 1473. I observed in the corona spectrum K 1250, K 1350 and K 1474. These coincidences are certainly very remarkable, especially the last. The positions of the faint lines (K 1250 and 1350) being only estimations, very little weight can of course be given them. But as to the position of 1474 in the corona spectrum there cannot be the least doubt. It

is the reversal of a well marked though not prominent line just below E, put down as *iron* by both Kirchoff and Angström, though not given by Huggins. Whether the position of the apparently coincident Aurora line is as well settled I am not yet certain, but hope to be able to ascertain before very long by a direct comparison between the spectrum of the Aurora and that of the electric spark from iron electrodes. At present it seems pretty likely that the spectra of the corona and the aurora borealis are identical with only such differences in the intensity of their lines as we might naturally expect, and that very probably the identity extends to the essential nature of the phenomena themselves.

Should it turn out that this line in the aurora does actually coincide with 1474, it will be of interest to inquire whether we are to admit the existence of *iron vapor* in and above our atmosphere, or whether in the spectrum of iron this line owes its presence to some foreign substance,—probably some occluded gas as yet unknown, and perhaps standing in relation to the magnetic powers of that metal.

Hanover, N. H., Sept. 13, 1869.

The above article comprises the substance of two papers read at the last meeting of the American Association for the Advancement of Science at Salem.

ART. XXXVII.—*Notes on the Geology of Western Texas and of Chihuahua, Mexico;* by JAMES P. KIMBALL, Ph.D.

THE road from San Antonio, Texas, to Presidio del Norte on the Rio Grande, by way of Fort Clark, Camp Stockton and Fort Davis, traverses the elevated Cretaceous table-land of western Texas which incidentally has been described in the reports of several government expeditions. Following this road, a belt of country reaching some fifty miles on either side of the 30″ parallel comes under observation. As far westward as the Limpia Mts. there is a gradual acclivity of the surface, which at short intervals is channeled by water courses, causing numerous valleys bounded by bold ascarpments of the Cretaceous limestone strata. The approximately level attitude of this formation gives rise to the mesa-top as seen from the valleys, while the mesas themselves, thus separated, rise successively from an altitude at San Antonio of 579 feet above the sea to 4688 feet at the head of the Limpia. In the case of the wide valleys, the streams have repeatedly changed their beds, most of which are dry except in times of heavy rain. The grassy

table-lands all have a basin configuration, there being toward the center a depressed portion usually containing drainage water. From the Limpia Mts. to the Rio Grande there is a gradual descent—the altitude of Presidio del Norte being 2779 ft.; but, unlike the eastern slope of the divide thus formed by the Limpia Mts. or Sierra Diavolo, between the Rio Grande and Pecos basins, the declining surface has no conformability with the stratification.

Orographically, it is true that the Limpia Mts., as described by Mr. Arthur Schott, form a part of a great dividing range between the Pecos and Upper Rio Grande, including the Guadaloupe and Sacramento mountains to the north, and the continuation south of the Limpia Mts. to form not however the Sierra Rica Mts. in Chihuahua, but the Sierra del Carmen, a range farther to the east, and through which the Rio Grande passes farther down near Presidio de San Vincente. My own observations do not justify the assertion that this range is characterized by *igneous* rocks, nor the inference that it is an axis of elevation.* At least on the Presidio del Norte road, the rocks are of a metamorphic aspect where not plainly Cretaceous—their topography being that of erosion. It was upon the evidence of specimens that Prof. Hall asserted the igneous nature of the Limpia range. These he characterizes as compact quartz, "derived doubtless," he says, "from the gelatinous silica produced by volcanic waters, reddish brown porphyry and a coarse granitic aggregate of which adularia forms a large part."†

However it may be in the case of the Guadaloupe and Sacramento mountains to the north, the Limpia Mts. near the 31st parallel are, as I shall proceed to explain, the last easterly development of what appears to be a metamorphic zone next overlying Cretaceous fossiliferous limestone, and probably included within the Cretaceous series, and known in Mexico as *cantera;* and quite overspreading a large portion of the state of Chihuahua—that portion, at least, to the north of the 28″ parallel, and as far west as the Grand Sierras. Within this area it is the surface formation of the eastern slope of the Cordilleras, except where local elevations have lifted, or erosion has bared, lower rocks. I traced it west beyond Cusihuiriachic whose altitude, determined by Dr. Wislizenus, is only 2181 feet less than that of the Cumbres de Jesus Maria—reputed to be the culminating point of the north Mexican Cordilleras (8375 ft.)‡ The peak

* Mex. Bound. Surv., i, Pt. II, p. 4. † Ibid, p. 107.

‡ Pedro Garcia Conde: Ensayo Estadistico sobre el Estado de Chihuahua. Chihuahua, 1842, p. 9. The same authority gives the altitude of the Mineral de Cusihuiriachic as 2362 varas (6564 ft.) above the sea; while the Cerro de Cuiteco is stated by Rémond to be the culminating point of the high Sierras.

of Cusihuiriachic, rising 1,643 feet above the village, and which is made up of this formation, thus exhibits its development so high up the Grand Sierras, as to leave a difference of less than 439 feet of summit altitude between the point where my observations ceased, and the highest point in the Cordilleras of this latitude, 100 miles farther west, which a bad state of the road rendered it impracticable to reach. Its continuation this whole distance indeed, is reported to me as a fact by Mr. John Potts of Chihuahua; as well as by Mr. W. S. Keyes of San Francisco, who entered the sierras from the Pacific side. The late Mr. A. Rémond described a series of what he distinguished as volcanic rocks, disposed in beds, and overspreading the Cretaceous argillaceous shales represented at Arivechi in Sonora, and which he found "extending from the Gulf of California, up to the very summit of the Sierra." The lithological characters and position of these rocks, briefly indicated in the valuable account of his explorations, prepared by Prof. Whitney, bear numerous striking analogies to the so-called *cantera* of the eastern slope.*

Near Hackberry Ponds, Texas, (about 26½° W. long. Wash.) where the rocks which form the body of the Limpia Mts. are first seen on the Presidio del Norte road, the configuration of the country suddenly changes, the arid Cretaceous table land east of that point giving way to grassy plains, bounded by rugged rocks. The gray Cretaceous limestone here passes out of sight, and is covered with a reddish brown, hard, compact rock, presenting the anomalous condition of a dense quartz matrix, colored by brown oxyd of iron, apparently *not feldspathic* itself, but containing minute translucent orthoclasic crystals; and minute irregularly shaped cavities filled with crystalline quartz, and coated with brown oxyd of iron which sometimes colors the quartz segregations. Thus we have the characters, not of a porphyry, but what may be called a *porphyritic quartzite.* It occurs in strata, which are gently undulating, and which rise toward the west by accumulation rather than by elevation, and thus form the Limpia Mts. Wild Rose Pass, by which the road crosses the mountains, and which mainly follows the eroded valley of the Limpia, a tributary of the Pecos, presents bold escarpments of this rock softer than where at first seen, and weathering excessively. This weathering or disintegrating action, due to the ferruginous character of this rock, goes far to produce its peculiar topography throughout its wide development. Nowhere to greater advantage can it be witnessed than in this pass, where the faces of the bluffs are weathered into massive columns, reaching in many cases from their base to top, and,

* Notice of Geological Explorations in Northern Mexico made during the years 1863–65. Proc. Cal. Acad. Sci., iii. (Extract, p. 5).

more or less perfect, fluting their whole surface which is of a dark ochreous color. A similar effect is to be seen in the bluffs back of Fort Davis. The lithological characteristics above noted here likewise prevail, but the rock is still softer than in Wild Rose Pass, and its sedimentary character more positive. A quarry opened by Maj. Gen. Merritt in the base of a high cliff of this rock, exhibits it to great advantage. Here the interior proves an earthy, or soft, fine-grained, alumino-silicious aggregate, containing scattered grains of quartz and minute crystals of pyrites. It is of light reddish and gray tints, quarries soft, and hardens on exposure. Of this material the officers' and other quarters are built. Thus, within a short interval, we find the same formation presenting the two lithological extremes, between which in its wider development it affords numerous varieties. The softer variety has all the characteristics of the *cantera*, of which the better structures of Chihuahua are built, and *which is found in all parts of the state under conditions similar to its occurrence at Fort Davis.* Hence I have adopted the Mexican term, and, as common, applied it to the whole formation. In this connection I may venture to mention, without attempting at present to support, the impression which these and correlative facts have forced upon me, namely, that the metamorphism of this formation consists of chemical and molecular changes under the influence of the atmosphere and percolating waters, and that the range of alteration will be found to be limited to the exposed portions.

The relation of the *cantera* at Fort Davis to the underlying Cretaceous limestone is rendered clear by the fact that a quarry for the supply of a lime-kiln has been opened by Gen. Merritt just below the level of the plain.

The disintegration of the surface formation seems to depend on the degree that it is ferruginous—the broadest plains and thickest soil always being found at the base of ochreous colored cliffs or ridges. This is best illustrated west of the Rio Grande. But by contrast with the neighboring topography of the limestone table-land such phenomena near Fort Davis are unusually marked—especially the distribution of the detritus of ferruginous rocks, and the action of rainwater in the leveling of expansive valleys, or the great grassy plains of this section, and causing the obliteration of former channels, scored out before the water-system had been altered by changes in level of the whole eastern slope of the Sierra Madre. By the rapid drainage of the skirting highlands in heavy rains, the plain is suddenly flooded by a sheet of water which, in its subsidence, carries with it toward the depressed or middle portion the fine sediments. These are continually being renewed, while the

* See a cut in Mex. Bound. Surv., i, p. 88.

plain is widened, by the disintegration of the bordering rocks. Gen. Merritt relates that the parade ground of the post is sometimes suddenly flooded to the depth of a foot, the water subsiding almost as quickly as it comes. The gardens of the post require protection against the loss of their soil by such floods.

Leaving Fort Davis to the north, the road in a few miles begins to desend into the Rio Grande basin, passing through a succession of wide champaign valleys skirted by table-land, capped with the *cantera* of a greenish tinge, as if colored by a silicate of iron—the ochreous coloration, and columnar weathering disappearing near Fort Davis. The prevailing dip, though scarcely appreciable, is toward the northeast, and hence the road, going southwest, is continually getting deeper in the geological section. Passing the water-hole of San Estevan at the base of a cliff of *cantera*, here also a porphyritic quartzite, a conglomerate is seen in the gullies. This is probably a cemented rubble common in Chihuahua at the base of the *cantera*, the cementing material, a carbonate, appearing to be derived from soluble ingredients in superincumbent strata which often are vesicular on weathering. Before reaching the Alamos the road has passed below the *cantera*, the lower portions proving very ferruginous and coarse grained. It disintegrates greatly—hills in all stages of dissolution being seen to have been composed of it. Between the Alamos and Presidio del Norte the road comes down to limestone, in some places saccharoidal and fossiliferous. Some twelve miles from the river, the valley proper of the Rio Grande is reached. In it five or six terraces of gravely material, varying from 20 to 100 feet in height, may be counted on either side. The town of Presidio del Norte is situated on the last one of the west side, or that nearest the present flood-plain of the river. Its altitude, according to the Mexican Boundary Survey, is 2,779 feet. The true valley of the Rio Grande here is from twenty to twenty-five miles wide, its western boundary—the limestone bluffs of the Sierra de las Cuestas.

This range is the continuation to the north of the Sierra Rica. At the base of this range near Nugal, which is twenty miles from Presidio del Norte on the Chihuahua road, and therefore incorrectly laid down on Fleury's map, are good exposures of heavy bedded calcareo-aluminous sandstone, dipping 15° N.W. —intercalated with impure calcareous shales. The former is exceedingly fossiliferous, furnishing the following Cretaceous, forms known in Texas: *Exogyra plicata*, *Scalaria Texana*, *Natica Texana*, *Lima Wacoensis*, together with species of *Ostrea*, *Inoceramus*, *Caprina* and *Ammonites*, and fish teeth. The Sierra Rica is made up of (1) lower calcareous shales and fissile slates; (2) blue limestone containing *Inoceramus;* (3) upper fissile cal-

careous shales; (4) arenaceous limestone, also containing *Inoceramus*, and probably the continuation of the more sandy beds seen at Nugal. This fossiliferous series is conformably capped on the highest mountains by a hard reddish rock of a bedded structure, and forming mesa or flat tops. It is characterized by a granular or aggregated quartz matrix, densely filled with rounded orthoclasic amygdules. Although thus conforming to the qualitative type of the crystalline *cantera*, and occupying its constant position with reference to the fossiliferous series, this rock forms a marked deviation from its common appearance. Local dips in the Sierra Rica are variable, though a prevailing one to the S.W. seems to be marked within the range of my observations, which were limited to a brief stay on account of the presence of hostile Apaches. The Sierra Rica lode, in which the mine of the same name has been opened to a depth of some 400 feet, is encased in the fossiliferous series, its highest outcrop being on the crest of a prong from which the summit quartzose rock of the neighboring mountains has been denuded. The lode has yielded rich sulphurets of silver, associated with sulphurets of the base metals, in a quartz veinstone enclosing breccia from the walls.

On passing out of the Rio Grande valley the acclivity of the surface again becomes appreciable. The Chihuahua road crosses the limestone range by the Cuesta de Gato, a depression in it some four miles beyond the Mula,* thirty-six miles from Presidio del Norte.

Here the limestone is pure, blue and brittle, with a conchoidal fracture. From this elevated pass the road descends immediately to the *jornada*—a great barren plain with a basin configuration, but without water or visible water-courses, and bounded by the mountains as indicated on Fleury's map. In the neighborhood of the road, it is covered with fine limestone detritus, overspread with a thin deposit of silt. The range of mountains to the west, including the Cuchillo parado, and the Sierra del Chupadores, rises some 450 feet above it. This range elevates the same limestone series as the Sierra Rica. But it consists mainly of heavy-bedded white and gray limestone, the upper shales only coming occasionally to view in the road-bed, on entering and leaving the *jornada*.

Passing round the base of the Chupadores, over a slight divide into another, smaller champaign valley beyond, a reddish diluvium is met with, some four miles north of the Gallina pass, the source of which is immediately traced to the development again here of the ferruginous summit rock (*cantera*) which comes in by the sudden pitch to the east of the underlying limestone in the gap, and caps apparently all the mountains to

* Incorrectly laid down on Fleury's map.

the east of the road, bordering the great *jornada*, viz,—the Sierra del Eclusero, Sierra de Encenillas, and the Sierra de las Mastenas, while the limestone range west has undergone no change of aspect. The same stratigraphical conditions prevail all the way to the Conchos. To the east of the road is seen a prominent development of the ferruginous *cantera*, while west the Choreras range, including the Amaragosa Mts., preserves the limestone series in heights of 400 to 600 feet. Within the range of the development of the *cantera* the usual remnants of hills in advanced stages of degradation are seen—a circumstance already indicated as common to this formation, and as going far to produce the peculiar conformation of the surface throughout its development.

The difference between the vegetation of the limestone soil and that resulting from the disintegration of the ferruginous *cantera*, is here marked the same as in the neighborhood of the Limpia Mts., Texas. The former produces the *mesquite* shrub, together with the *mesquite* variety of grass, while the latter is covered with *gramma* grass, and is destitute of mesquite.

The Conchos river flows close to the base, and seems to occupy an anticlinal axis, of what I have designated as the Choreras and limestone range, which extends from near Julimes N.E. to Presidio del Norte. Under the additional erosive influence of its two affluents—the Rio Sacramento, which joins it at San Diego, and the Rosales at Julimes—great expanse has been given to the bottom of the Conchos. From the Choreras, east, to the Santa Eulalia range, west, it is some twenty-five miles broad. It is covered with a fine, and somewhat ferruginous, calcareous alluvium, which, thoroughly irrigated, is under high cultivation. It contains several populous towns, and a number of fine ranches. Fuel from the root of the *mesquite* is yet comparatively abundant. The limestone bluffs of the Choreras are the most westerly prominent outliers of the Cretaceous fossiliferous limestone, yet bosses of the same formation along the prolongation of the same axis of elevation, occur at intervals in the sub-structure of mountains for some seventy miles further—as near Carretas and in the Sierra de Magistral.

The famous silver mines of Santa Eulalia are in the midst of the long narrow N. and S. range, of the same name which bounds the great outspread of the Conchos bottom near Julimes, an intermediate range which marks its valley below having been here obliterated. In the body of the range, the limestone has given way to the *cantera*, except in the mining district of some five square miles, where on a prolongation, as above mentioned, of the Choreras axis, a single boss elevates with quaquaversal dips, the limestone again. The limestone, the same as at Sierra Rica, is the seat of the silver deposits,

which are of an irregular description, and probably unique. These will be described in a future number of this Journal. Suffice it to notice at present the frequent occurrence in the silver-bearing beds, of *Radiolites*, *Pecten*, *Inoceramus*, and a characteristic mesozoic coral. All along the limestone range mineral deposits are known. In the Chenati Mts.—its prolongation into Texas—argentiferous galena and stibnite occur. The Cuchillo parado and the Choreras are both reputed mineral localities, as likewise the Sierra de Magistral, as its name implies.

In the Dolores pass, by which the road crosses the Santa Eulalia range, no limestone occurs, the elevations being entirely of *cantera* of various tints, and distinctly stratified. The cemented rubble, to which allusion has been made, is seen in this pass, varying from a coarse to a fine breccia. Such deposits are found throughout central Chihuahua under the diluvium of the plains, and in low places among the mountains. In some places it is indurated, and in this condition might easily be mistaken for a regular, instead of a recent deposit, and be thought to enter into the stratification which it never does.

From the Conchos to Concepcion the mountains and river system are approximately north and south. And the same may be said of the whole eastern slope of the Cordilleras all the way to the Rio Grande, except where the presence of limestone elevations has served to modify the uniform topography of the *cantera*. This uniformity consists in the succession of narrow and continuous north and south ridges with foot hills, separating broad and, longitudinally, remarkably continuous valleys. The whole surface, thus characterized, rises toward the west, while the mountains gain somewhat in height and the valleys in breadth in the same direction. Such is the configuration quite to the summit of the Cordilleras in this latitude, and it is thus almost insensibly reached. The term, Sierra Madre, is for this reason seldom heard in Chihuahua. The western slope in Sonora is rugged and steep.

The cantera of the mountains, while conforming to one qualitative type is presented under various conditions of color, aggregation and structure. Though generally occurring in pretty level beds, it is much jointed, and sometimes exhibits oblique cleavages so continuous as to resemble stratification under a high dip. Such an appearance is produced in the range directly east of the city of Chihuahua, where the Sacramento river passes through it. The champaign valleys, which are filled with the detritus of the more ferruginous *cantera*, generally contain, west of Chihuahua up toward the humid belt, small running streams, or shallow lakes, which fit them for cultivation. Some of these valleys are over a hundred miles in length.

Between the city of Chihuahua and El Paso del Norte the physical and lithological features of the *cantera* still prevail. The road lies over the plain of Encenillas—one of the typical valleys above described, extending, together with its bordering mountains, within twenty miles of the Rio Grande where limestone hills are again met with, forming the bluffs of the valley. This limestone seems to bear the same relation to the *cantera* as the Cretaceous beds at Presidio del Norte below. Hence I must take exception to the determination of this limestone by Dr. Wislizenus as Silurian, especially as this was upon the inadequate evidence of an "injured and imperfect" coral which he refers to *Calamopore*, and a bivalve shell of the genus *Pterinea*. I did not stop to collect fossils at this locality, no question having been present to my mind on the spot as to its equivalency with the Cretaceous as elsewhere observed, and as I was not then acquainted with Dr. Wislizenus's report.* The discrepancy between the lithological terms employed by Dr. Wislizenus and myself proceed from a difference of observation and reasoning. The *cantera*, (which term I have employed for short) whose characteristic and varying qualities have been detailed, and which has been described as a surface metamorphic formation, horizontally bedded and comparatively undisturbed, attaining a thickness of over 1700 feet, where found within the range of my observation least reduced by denudation (at Cusihuiriachic), and overspreading the middle and northeastern part of Chihuahua, and probably also the western part, Dr. Wislizenus designated generally as porphyry, and sometimes as granitic, and again as trachytic. That what he thus terms is really the so-called *cantera*, under its various aspects, is clear from his specifying the building stone used in the city of Chihuahua, from which I have taken its local name, as white porphyry, as well as from the fact that he distinguished as granitic and porphyritic its continuation on either side of the El Paso road. He similarly characterized the rock which forms the mountains of Cusihuiriachic, seventy-nine miles west of the city of Chihuahua. Thus it will be seen that in this respect our observations agree as to the extent and identity of the mountain formation, but that we differ as to its origin and lithological character. The orographic features of the country as phenomena of denudation have not been noticed by this traveler. And the determination of the limestone twelve miles N.E. of Chihuahua (Santa Eulalia) as Silurian upon the insufficient evidence of a simple specimen, received at second hand, containing "some chambers of an *Orthoceras*," cannot be accepted in the light of

* Memoir of a Tour to Northern Mexico, connected with Col. Doniphan's Expedition in 1846–7. Senate Doc., Misc. 26, 30th Cong. 1st Ses. See also Report of Dr. Parry: Mex. Bound. Surv., vol. i, Pt. 2d, 8, 9. On the Silurian in the Rocky Mts., see a notice by Prof. J. D. Whitney, Proc. Acad. Nat. Sc., iii, 307.

the significant evidence above brought forward to prove the Cretaceous age of the same limestone. In the geological sketch given by Dr. Wislizenus, the formations are laid down according to his description.*

The number of Cretaceous fossils collected by myself west of Presidio del Norte, quite disproves the position of Dr. Parry, viz., that the "natural boundaries of this basin (near Presidio del Norte) consist of irregular mountain ranges composed principally of carboniferous limestone similar to that seen above" (near El Paso.)† But Dr. Parry in this matter seems to follow Prof. Hall who referred the limestone of this section to the carboniferous exclusively on the ground of the lithological analogy with the Carboniferous limestone in numerous western localities, of a simple specimen from the rapids of the Rio Grande, in which no fossils could be recognized.‡ With regard to the "compact and vesicular lavas, and volcanic and friable breccias, etc.," thus termed by Prof. Hall, in the collection of Dr. Parry, it is proper to suggest the former to be referable to the *cantera* in some of its aspects of coloration, aggregation, and weathering, and the latter to be the cemented rubble above noticed. The limestone back of Presidio del Norte, unmistakably Cretaceous, is brought to the surface by the Conchos axis of elevation, which is so prominent till cut through at the bend of that river, and which does not finally expire for yet a distance of some seventy miles to the southwest. Topographically as well as stratigraphically, this is the lowest part of the state which I visited, and the only part I found either not overspread with, or bearing on its heights, the *cantera*, which even along the easterly development of this axis, it will be understood, has disappeared but from a narrow belt.

The extension of the fossiliferous Cretaceous so far up toward the summit of the Cordilleras, has an important bearing upon the occurrence of Texas Cretaceous fauna in Sonora, where they were found by the late Mr. Rémond. Prof. Gabb, to whom we owe this identification, calls attention to the discovery as going to show a "water communication between the great Cretaceous sea that covered so much of what is now the central portions of our continent, on the one side, and the Pacific, on the other." The recognition of the Cretaceous near Arivechi in Sonora, according to Mr. Gabb, proved only the second reported locality

* We much incline to doubt whether Fremont, Stansbury or Wislizenus have brought unequivocal Silurian rocks or fossils from several points in the Rocky mountains. See an editorial critique on a geological map by Jules Marcou (this Journal, vol. xvii, p. 202), by him attributed to Prof. Hall (Geol. North America, two reports, etc., 1858, pp. 93 and 98.)

† Mexican Bound. Surv., i, Pt. 2d, p. 50.

‡ Ibid. p. 110.

of its occurrence in the whole area of Mexico, the other being in the State of Puebla.*

So important a discovery as the occurrence of rich silver deposits in the *fossiliferous*, as well as the metamorphic Cretaceous of Chihuahua, cannot adequately be treated within the scope of a general article; and I therefore reserve for a subsequent number of this Journal, descriptions of the interesting silver mining localities of Santa Eulalia, Cusihuiricahic and Cieneguilla, of which incidental mention has already been made.† Although the metamorphic Cretaceous is, through the labors of the Geological Survey of California, well known in numerous localities in the Coast Ranges, as a seat of gold deposits; and the Jurassic, east of the High Sierras within the territory of the United States, as a seat of silver deposits, the instances above given of the unequivocal fossiliferous Cretaceous, as well as a probable metamorphic and later zone of the same series, as sources of silver ores, are the first in North America yet reported. The only parallel occurrence yet brought to light, so far as I am aware, is in Chili, where according to Mr. Rémond, calcareous fossiliferous Cretaceous strata carry silver deposits, evidently much in the same way as at Santa Eulalia.‡

New York, Aug. 10, 1869.

ART. XXXVIII.—*Contributions to Zoölogy from the Museum of Yale College.* No. IV.—*Abstract of a Notice of the Crustacea collected by Prof. C. F. Hartt, on the coast of Brazil in* 1867; by SIDNEY I. SMITH.

THE paper of which the following is a short abstract, was printed during July and August, in the second volume of the Transactions of the Connecticut Academy, but the whole edition, excepting a few copies of the first two signatures which had been distributed, was destroyed by fire in September last. During the delay consequent to the reprinting of the Transactions, this article seemed desirable.

The collection, although quite small, is of interest from the large proportion which it contains of species heretofore known only from Florida or the West Indies. The following is a list of the species with the localities at which they were collected by Prof. Hartt.

* Geol. Surv. of California, Palaeontology, ii, p. 257.

† These three localities have produced during the last 150 years from 200,000,000 to 300,000,000 of dollars, mainly during the last century.

‡ Proc. Cal. Acad. of Sc., iii, 1866; Phillips' Mining and Metallurgy of Gold and Silver, p. 318; Domeyko, Ann. des Mines (4), ix, 22.

Milnia bicornuta Stimp.—Reefs of the Abrolhos.
Mithraculus coronatus Stimp.— " "
Mithrax hispidus Edw.— " "
Xantho denticulata White.— " "
Chlorodius Floridanus Gibbes.— " "

Panopeus politus Smith (Proc. Bost. Soc. Nat. Hist., vol. xii, p. 282, 1869; Trans. Conn. Acad., vol. ii, p. 3, plate i, fig. 4).—Reefs of the Abrolhos.

Panopeus Harttii Smith (Proc. Bost. Soc. Nat. Hist., vol. xii, p. 280; Trans. Conn. Acad., vol. ii, p. 5, plate i, fig. 5).—Reefs of the Abrolhos.

Eriphia gonagra Edw.—Reefs of the Abrolhos.

Callinectes Danæ Smith (Trans. Conn. Acad., vol. i, p. 7; Lupa diacantha Dana; *non* Lupa diacantha Edw., *nec* Calli; nectes diacantha Stimp.).—Pernambuco and Bahia.

Callinectes ornatus Ordway.—Caravellas, Province of Bahia.

Callinectes larvatus Ordway.—Bahia.

Acheloüs spinimanus De Haan.—Bahia.

Acheloüs Ordwayi Stimp.—Bahia.

Goniopsis cruentatus De Haan.—Reefs of the Abrolhos.

Cryptograpsus cirripes Smith (Trans. Conn. Acad., vol. ii, p. 11, plate i, fig. 3).—Rio de Janeiro (Coll. Peabody Acad. Sci.)

This species differs from the *C. angulatus* Dana, heretofore the only known species of the genus, in having the front as seen from above nearly straight instead of deeply bilobed, in the much greater breadth of the carapax between the outer orbital teeth—the ratio of this breadth to the breadth of the carapax being 1:1·43, while in *C. angulatus* it is 1:1·68,—and in having the posterior legs densely ciliated. Length of carapax in a male, 31·0^{mm}; breadth of carapax, 35·6^{mm}.

Uca cordata (Cancer cordatus Linn.)—Bahia.

Cardiosoma quadratum Saussure.—Pernambuco.

Dromidia Antillensis Stimp.—Reefs of the Abrolhos.
Petrochirus granulatus Stimp.— " "
Calcinus sulcatus Stimp.— " "

Clibanarius vittatus Stimp—Caravellas, Province of Bahia.

Clibanarius sclopetarius Stimp.—Caravellas River.

Clibanarius Antillensis Stimp.—Reefs of the Abrolhos.

Scyllarus æquinoxialis Fabr.—Bahia.

Panulirus echinatus Smith (Trans. Conn. Acad., vol. ii, p. 20).

This species is closely allied to *P. guttatus*, but differs from the figures and descriptions of that species, in having the spaces between the spines of the carapax tuberculose and hairy instead of smooth, the third pair of thoracic legs extending beyond the second instead of the second being longer than the third, and the trausverse sulcus of the third abdominal segment interrupted in the middle. In the posterior thoracic legs of

the female, the dactylus is short and armed on the posterior side of the base, with a stout process which closes against a similar process from the extremity of the propodus, both processes being hairy on the outside, and having horny spoon-shaped tips.—Pernambuco.

Alpheus heterochelis Say.—Reefs of the Abrolhos.

Palæmon Jamaicensis Olivier.—Penêdo, Rio Sao Francisco.

Palæmon forceps Edw.—Mouth of the Pará.

Palæmon ensiculus Smith (Trans. Conn. Acad., vol. ii, p. 26, plate i, fig. 2.—Pará.)

Rostrum very long, strongly curved downward for the basal half of its length, the terminal half very slender, nearly straight, but strongly inclined upward, armed above with nine to twelve short teeth of which seven or eight are on the basal portion, and the others near the tip, and below with eight to twelve teeth. Second pair of thoracic legs in the male very long and quite slender, in full grown specimens, the merus reaching beyond the tip of the antennal scale, and all the segments to the base of the fingers closely beset with short spinules; hands cylindrical, not swollen, the fingers slender and sparsely clothed with short, downy pubescence; in the females and young the second pair of legs smaller and much less spinulose. Penultimate segment of the abdomen long and narrow, the length above being twice as great as the breadth; terminal segment narrow and tapering regularly to a very slender and acute point. Length, 65 to 100^{mm}.

Peneus Brasiliensis Latr.—Bahia.

Xiphopeneus Smith, gen. nov., (Trans. Conn. Acad., vol. ii, p. 27).

Carapax much as in *Peneus*, but the rostrum very long and slender, and the gastro-hepatic sulcus scarcely perceptible, while the cervical and branchio-cardiac sulci are distinct. Lamelliform appendages on the inside of the peduncle of the antennulæ very small, not expanded over the eye as in *Peneus*; antennulary flagella very long and slender, the upper ones much stouter and longer than the lower. Antennæ, maxillipeds and the three anterior pairs of thoracic legs nearly as in *Peneus*. Fourth and fifth pairs of legs very long, the terminal segments very slender and flagelliform.

Xiphopeneus Harttii Smith (Trans. Conn. Acad., vol. ii, p. 28, plate i, fig. 1.)—Caravellas, Province of Bahia.

Rostrum as long as, or considerably longer than the carapax, wholly unarmed below, but the basal portion with a thin carina above, which extends back upon the carapax and is armed with six sharp teeth, the terminal portion is subcylindrical, unarmed, and tapers to a very slender point far in front of the antennal scales. Upper flagellum of antennula

about three times as long as the carapax; lower flagellum very slender and half as long as the upper. Thoracic legs of the first pair reaching to the middle of the propodus of the external maxillipeds, slender, beset with stiff hairs along the edges, and the basis armed with a spine on the inside near the articulation with the ischium; second and third pairs of legs successively a little longer, smooth and unarmed; legs of the fourth and fifth pairs smooth and unarmed, all the segments, except the coxal and basal very slender and very much prolonged, the terminal segments being fully as slender as the terminal portions of the flagella of the antennulæ.

Gonodactylus chiragra Latr.—Reefs of the Abrolhos, Caravellas.

Of the 32 species in the foregoing list, 21 are new to the fauna of Brazil; of these 21 species, 6 are described as new, and the remaining 15 are all species previously known from the West Indies or Florida. The 11 species in Prof. Hartt's collection which were previously known from Brazil are all, with the exception of *Callinectes Danæ*, now known from the Caribbean fauna.

The account of Prof. Hartt's collection is followed by a list of the described species of Brazilian Podophthalmia with their geographical distribution. One hundred and five species are enumerated but the actual number of described species is probably somewhat less, as several are admitted on questionable authority and some others will doubtless prove to be synomyms. In this list the following changes in nomenclature are introduced:—

Acheloüs Sebæ=Neptunus Sebæ A. Edw.

Eucratopsis is proposed as a new genus for the reception of *Eucrate crassimanus* Dana, Stimpson, in Boston Journal Nat. Hist., vol. vii, p. 588, having shown from an examination of specimens of *Eucrate crenatus* that De Haan's genus has the male organs, or verges, arising from the coxæ of the posterior legs and therefore belongs to the *Carcinoplacidæ* of Edwards, while in *E. crassimanus* the verges are sternal. The genus thus constituted appears to be nearest allied to *Speocarcinus* Stimpson (Annals Lyc. Nat. Hist., New York, vol. vii, p. 59), but it is quite distinct in the larger orbits, the approximation of the inner margins of the external maxillipeds, and in the much greater narrowness of the posterior part of the sternum.

Trichodactylus (?) *Cunninghami*=Uca Cunninghami Bate.

Pachygrapsus rugulosus=Letograpsus rugulosus Edw.

Petrolisthes leporinus=Porcellana leporina Heller.

Petrolisthes Brasiliensis, sp. nov=Porcellana Boscii? Dana (*non* Savigny).

ART. XXXIX.—*Notice of some new Mosasauroid Reptiles from the Greensand of New Jersey;* by O. C. MARSH, Professor of Paleontology in Yale College.

A STRIKING difference between the reptilian fauna of the Cretaceous of Europe and America is the prevalence in the former of remains of *Ichthyosaurus* and *Plesiosaurus*, which here appear to be entirely wanting; while the Mosasauroids, a group comparatively rare in the Old World, replace them in this country, and are abundantly represented by several genera, and numerous species. Recent explorations in the Cretaceous deposits of the Atlantic border, and in the region west of the Mississippi have resulted in the discovery of many new forms of this peculiar type of reptilian life, and furnished material for a more satisfactory study of its structure and affinities, which have so long remained in doubt. The investigations already made by Professors Leidy, Cope, and others have removed many uncertainties in regard to the true nature of these reptiles, and disclosed affinities with other groups, before unsuspected. The interesting remains of *Mosasaurus* and its allies, which are briefly characterized in the present paper, promise to throw much additional light on this subject, and will be described in full, with illustrations, at an early day.

Mosasaurus princeps Marsh, sp. nov.

This species is indicated by the most important parts of a skeleton which is perhaps the largest hitherto found in this country, as when entire the animal was probably not less than seventy-five feet in length. The remains are in an excellent state of preservation, and among them are the greater portion of the skull, with the maxillary teeth; one perfect quadrate bone; one mandible, nearly complete, with many of the teeth, and the posterior portion of the other; about twenty vertebræ, and several bones of the extremities.

The teeth are smooth or very slightly facetted, and much curved inward and backward, especially in the posterior part of the jaws. The external pedicle of the crown is short, and its surface very concave. The dorsal vertebræ are very cylindrical; the caudals slightly flattened below, and furnished with anchylosed chevron bones. The ribs preserved are most of them cylindrical and slender like those of serpents, but are not hollow. Some of the smaller ones, apparently from the posterior dorsal region, are flattened transversely, and have the articular head nearly round, and slightly convex. The suspensorium of the quadrate bone is clasped by the proötic above, and the exoccipital below, and the squamosal forms the greater part of the glenoid cavity. The

articular faces of the right subarticular and splenial bones are complete, and indicate that the peculiar joint in the lower jaw, characteristic of the Mosasauroids, was, in this species, more adapted for vertical, than for lateral motion, although the latter was to some extent possible.

This species appears to be readily distinguished from those already known, with the exception, perhaps, of *Mosasaurus maximus* of Cope, which has not yet been fully described. So far as it has been defined, however, it presents marked differences from the present species, particularly in the quadrate bone, one of the most characteristic portions of the skeleton. In *M. princeps*, the proximal end of the quadrate forms an open sigmoid, the process at the angle over the great ala is much smaller than that of the external angle, and the knob just within the meatus of the ear is very prominent. There is also a large foramen near the medial line, a little below the center, which is not given in Prof. Cope's figure of the quadrate of *M. maximus*.* The left quadrate of the present specimen is eight inches in length, four and two-thirds inches in breadth from the outer side of the pit near the meatus to the edge of the great ala, and five inches across the articular face of the distal extremity.

The geological position of these remains was in the first or lower bed of Cretaceous greensand, or Marl. They were all found together in July last near Hornerstown, Monmouth county, New Jersey, during the excavation of a ditch by the well known Cream Ridge Marl Company, and, with most of the specimens described below, were presented to the Peabody Museum of Yale College by John G. Meirs, Esq., in behalf of the Company. The thanks of all friends of science are justly due to Mr. Meirs and the other Directors for their intelligent zeal and liberality in preserving such valuable specimens, and rendering them available for investigation.

Mosasaurus Copeanus Marsh, sp. nov.

The remains which at present represent this species are portions of a skull with some of the maxillary teeth, and part of the corresponding lower jaws, including the anterior extremity of the left ramus, and the articular surface of the left splenial bone. They indicate one of the smallest Mosasauroids yet discovered, and one very distinct from any hitherto known. The teeth are slender, compressed, considerably curved, and deeply facetted. They are very pointed, and a sharp ridge, without denticulations, divides the outer from the inner surfaces. The enamel of the crown is remarkably smooth, and quite unlike the usual corrugated dental surfaces of the larger Mosasauroids. The dimensions of a very perfect tooth from near the middle of the left lower jaw are as follows:—

* Transactions of Am. Philosophical Soc., vol. xiv, pl. xi, fig. 7, 1869.

Length of crown and osseous support,	1 inch, 11·	lines.
Length of crown alone,	10·5	"
Antero-posterior diameter of crown at base,	5·25	"
Transverse diameter of crown at base,	4·	"

The fang-like supports of all the teeth are more firmly coössified with the jaws than is usually the case in this family, and most of them contain excavations for the successional teeth. On the outer superior edge of the lower jaws there is a row of pits, round or oval in outline, and alternating with the teeth. In most instances one is situated outside and a little in front of each tooth, and those in the anterior portions of the jaws are deeper than those farther back. They evidently have been excavated by the maxillary teeth, and are adapted for their reception, like the similar cavities in the jaws of crocodiles. Slight depressions, corresponding to these in position, may be seen in the jaws of some of the larger species of *Mosasaurus*, and the unusual depth of the pits in the present specimen is probably due to the more pointed character of the teeth.

Among the pieces of the skull preserved, is part of a symetrical bone, about seven inches in length, which formed the superior, medial portion of the face in front of the orbits. Although no sutures are visible, it is evidently composed of the nasal bone, and portions of the attached premaxillary and frontal bones. Its upper surface is very peculiar in form, and is doubtless quite characteristic of the species. It is slightly concave in front where broken off, flat at its narrowest part between the nasal openings, convex as it becomes broader a little farther back, next flat with regular beveled edges at its greatest width between the apertures, and finally very convex as it again expands before coalescing with the medial frontal. This fragment indicates that the nasal bone was very slender, and, like the premaxillary, undivided; that the superior nasal openings on either side were long and narrow, and that the central line of the face immediately behind them was marked by a low rounded ridge.

This species will be easily distinguished from the Mosasauroids hitherto described, with the possible exception of the *Holcodus accutidens* of Gibbes,* which was founded on specimens including teeth of *Hyposaurus*, and a single dental crown apparently similar in size and general appearance to the teeth here described. The latter, however, appear to all have the crown more unequally divided by the acute edges, and they also have facets at the base of the inner surface in place of the strong striæ which suggested the generic name *Holcodus*.

The present remains indicate an animal about twenty-five feet in length. They are from the lower Cretaceous greensand bed

* Smithsonian Contributions, vol. II, Art. 5, p. 9.

at Marlborough, Monmouth county, New Jersey. The species is named for Professor E. D. Cope, of Philadelphia.

Mosasaurus Meirsii Marsh, sp. nov.

This species is indicated by the crown of a single tooth which was found in the lowest Marl bed, near Hornerstown, New Jersey. It evidently belonged to a Mosasauroid reptile of moderate size, but appears to differ from the teeth of any yet described in being more pointed, and in having the sides very deeply facetted, or grooved. It resembles strongly the teeth of *Mosasaurus Copeanus*, but is more compressed, the enamel of the crown more corrugated, the cutting edges are minutely denticulated, and it evidently belonged to a much larger animal. The crown is an inch and five lines in length, and eight lines in antero-posterior diameter at the base. The facets fade away before reaching the apex, which is nearly smooth.

This tooth is apparently too large for either of the species of *Halisaurus* described below, the remains of which were found in the same immediate vicinity, but it may possibly belong to *Macrosaurus lævis*, or *M. validus*, the teeth of which are unknown. In the absence of any evidence on this point, it may very appropriately be named for the discoverer, Mr. John G. Meirs, who has rescued for science so much valuable material relating to *Mosasaurus* and its contemporaries.

Halisaurus platyspondylus* Marsh, gen. et sp. nov.

Macrosaurus platyspondylus Marsh, American Association of Science, Salem Meeting, August, 1869.

This genus is especially characterized by the great depression of the centra of the vertebræ, which gives the articular ball and cup a very transverse elliptical outline, exceeding in this respect apparently those of any other Reptilia. The vertebræ, so far as known, are also elongate, and without the zygosphenal and zygantral articulation. In the anterior part of the series the cup is deep, thin lipped, and more concave transversely than vertically. In outline it is somewhat concave, and its face is directed slightly downward. The neural arch rests upon the anterior three-fourths of the centrum, and the spine is of medium height. The neural canal is a broad vertical oval. The diapophyses have a general resemblance to those of *Mosasaurus*, but in the anterior part of the vertebral series are more compressed, and extend forward and downward, projecting below the inferior surface of the centrum, like the corresponding pedunculate processes in some of the serpents. The Ophidian affinities of this genus appear to be further indicated by the hypapophysis, which in the posterior cervicals, at least, is wedge-shaped, and

* Ἅλς, *the sea*, and σαῦρος, *a lizard*.

descends vertically from the posterior part of the centrum, resembling strongly the hypapophyses of the medial trunk vertebræ of the constricting snakes, especially the Eocene *Palæophis*, which may, perhaps, yet prove to be a descendant of some of the Mosasauroids. The present genus appears to have its nearest allies in *Macrosaurus* and *Clidastes*, especially the former, which has, however, the dorsal vertebræ more or less compressed. From the latter genus it may readily be distinguished by the absence of the zygosphenal articulation.

The remains on which the species is founded consist of a posterior cervical, and an anterior dorsal vertebra; the right splenial bone with its concave articular face, and a small portion of the base of the skull. A coracoid found near these specimens probably belonged to the same animal, although it is smaller than the other parts of the skeleton would apparently indicate, and differs considerably in form and proportions from the corresponding bone in both *Macrosaurus* and *Clidastes*. The splenial bone differs from that of *Mosasaurus* in the form of its articular face, and in being more overlapped in front of the joint by the dentary. The dimensions of the posterior cervical vertebra are as follows:—

Length of centrum below,	2 inches,	6	lines.
Transverse diameter of articular cup,	1 "	8·5	"
Vertical diameter of articular cup,		11·	"
Distance from center of cup to middle of lateral edge,		11·	"
Length of diapophyses below lower margin of cup,		5·5	"
Length of hypapophysis below lower margin of ball,		8·	"

The dorsal vertebra has no trace of a hypapophysis, and the lower surface of the centrum is remarkably flat. The anterior downward prolongation of the diapophyses still project below the centrum, but they have become obtuse processes, partially separated from the more vertical portion of the diapophyses by a notch. The following are the more important dimensions of this vertebra:—

Length of centrum below,	2 inches,	6·	lines.
Transverse diameter of cup,	1 "	9.	"
Vertical diameter of cup,	1 "		
Width of neural canal below,		6·	"
Width between extremities of anterior zygapophyses,	2 "	3·	"
Length of diapophyses below lower surface of centrum,		2·	"

These remains, which were recently discovered by Mr. Meirs in the lower Cretaceous Marl bed at Hornerstown, New Jersey,

indicate an animal about thirty feet in length. If the coracoid found near them belongs to the same skeleton, the body was remarkably slender, and the fore limbs possessed comparatively little power.

Halisaurus fraternus Marsh, sp. nov.

This species is established on an anterior dorsal and two posterior dorsal vertebræ, found not far from each other, and probably part of the same series. They are about the same size as those just described, and have many points of resemblance to them, but differ in having the centra less depressed and less elongate. The anterior dorsal has the zygapophyses less expanded, and their articular faces more nearly vertical than the corresponding parts in the previous species. It has also indications of a small hypapophysis, which in form and position resembles somewhat that of *Mosasaurus*. The neural spine is compressed, of moderate height, and directed slightly forward. The posterior dorsals have the centra considerably less depressed than the anterior dorsals, and the neural arch rests upon the anterior two-thirds of the centrum. The diapophyses pass off horizontally, their upper flat surfaces being nearly in the same plane as the floor of the neural canal. At their extremities there is an articular face which is subtriangular. These vertebræ are all much more depressed than those of *Macrosaurus lævis* Owen, or *M. validus* Cope, and indicate an animal smaller than either of those species, probably twenty-five or thirty feet in length. The remains were found at Hornerstown, New Jersey, by Mr. Meirs, at the same locality as those described above.

Yale College, New Haven, Conn., Oct. 20th, 1869.

ART. XL. — *Description of a new and gigantic fossil Serpent (Dinophis grandis), from the Tertiary of New Jersey;* by Professor O. C. MARSH of Yale College.

THE earliest remains of *Ophidia* both in Europe and this country have been found in the Eocene, and nearly all the species from strata older than the Post Pliocene appear to be more or less related to the constricting serpents. Remains of this character are not uncommon in European rocks, but in this country two species only, one founded on a single vertebra, have been described hitherto, and both of these were discovered in the Tertiary greensand of New Jersey. An interesting specimen from the same formation, recently presented to the Museum of Yale College, indicates a third species, much larger than either of the others, in fact superior in size to any known fossil ophidian, and not surpassed by the largest of modern serpents.

This species is represented by a single dorsal vertebra, somewhat injured, but with the neural arch well preserved. The general form of the centrum is elongate, and considerably compressed behind the middle. The articular cup and ball are subtriangular ovate, and their faces are much more nearly vertical than is usual in ophidian vertebræ, the cup looking but very slightly downward. The neural arch is elevated, and massive. The neural canal is broader than high, and its floor depressed posteriorly, with indications of a slight medial epapophysis. The sides of the canal are marked by a sharp longitudinal ridge, which, in connection with the arched roof above, gives a trifoliate outline to a transverse section of the opening, as in some species of *Python*. The floor of the neural canal is somewhat below the plane of the anterior zygapophyses. The zygosphene is much elevated, and its summit concave. It is narrower than the articular cup, a feature which appears to be peculiar to fossil serpents alone. Its anterior surface is deeply excavated, and the lateral margins extend from the base downward and outward to the superior edge of the cup, thus continuing the sides of the neural canal forward. The zygantrum is comparatively shallow, and has its greatest depth on the medial line. Its base extends downward and backward until directly over the superior margin of the ball, protecting also from above the neural canal posteriorly. The neural spine is much compressed, triangular in outline at its base, and does not extend to the anterior margin of the zygosphene. The base of the neural arch is strengthened by a thick rounded ridge, which unites the zygapoyphyses on each side. It begins below the plane of the anterior zygapophysis, and ascending slightly, joins the posterior zygapophysis above the articular face. Remnants of two hypapophyses connected by a prominent ridge exist, and show that the anterior process was much the smaller, and its base somewhat separated from the margin of the cup.

The principal dimensions of this vertebra, which is apparently an anterior dorsal, are as follows:—

Length of centrum from edge of cup to convexity of ball,	14·25	lines.
Transverse diameter of cup,	9·10	"
Vertical diameter of cup,	7·5	"
Distance from top of zygosphene to lower margin of cup,	13·25	"
Vertical diameter of ball,	7·25	"
Width of neural canal in front,	3·75	"
Height of neural canal in front,	2·5	"

The present species is quite distinct from *Palæophis halidanus* Cope, which somewhat resembles it in size. The original specimen on which the latter species was founded is now in the Mu-

seum of Yale College, and a comparison shows that the centrum is much more depressed, the cup and ball more transverse, and the ridge uniting the zygapophyses narrower in proportion, and less rounded. From the vertebræ of *Palæophis littoralis* Cope, which it most nearly resembles in general form, outline of cup, and hypapophyses, the present specimen differs especially, judging from the description and figures,* in having the plane of the anterior zygapophyses above the floor of the neural canal, and the ridge between the zygapophyses not parallel with the centrum. The zygosphene is also more elevated, and the top of the neural canal more rounded in front. The bulk of the present vertebra is, moreover, at least three times that of *Palæophis halidanus*, and five or six times that of *P. littoralis*. It is also considerably larger than any vertebra described by Professor Owen in his valuable Memoir on the Tertiary Ophidia of England,† as well as quite distinct from any of the species there defined.

The present specimen is evidently identical generically with the two species already described by Professor Cope, but in comparing these various remains with typical specimens and figures of the species placed by Professor Owen in his genus *Palæophis*, several marked differences between the two groups will be observed, which would seem to justify their separation. For the reception of the American species, therefore, the genus *Dinophis*‡ is proposed. Among the most apparent differences between this genus and *Palæophis*, to which it is closely related, are the following:—The base of the neural spine in *Dinophis* is not coextensive with the supporting arch, but rises a short distance back of the anterior margin of the zygosphene, as in the existing *Python*. The ridge connecting the anterior and posterior zygapophyses is much more developed, and its continuous crest more rounded. The sloping sides of the arch above the neural canal are more deeply concave, and an obtuse ridge separates the concavity from the anterior zygapophysial notch. The neural canal has a sharp longitudinal ridge on each side, which gives its transverse section a trifoliate outline, as in *Python*. The zygosphene is more excavated anteriorly, and its summit is concave. The zygapophyses are more extended outwardly, and the hypapophysial ridge is more prominent.

The vertebra here described would indicate an animal not less than thirty feet in length, probably a sea-serpent allied to the Boas of the present era. In view of its superior size, the species may appropriately be named *Dinophis grandis*. This interesting specimen was found in the Eocene greensand, near

* Proc. Acad. of Nat Sci. Philad., 1868, p. 234, and Trans. Am. Phil. Soc., vol. xiv, Plate V, 1869.

† Paleontological Society of London, 1850.

‡ Δεινός, *terrible*, and ὄφις, *a serpent*.

Shark River, Monmouth county, New Jersey, and was presented to the Peabody Museum of Yale College by Dr. W. S. Kimball, of Eatontown in that state.

A synopsis of the known American species of fossil *Ophidia* will at present, in accordance with the above determinations, stand as follows:—

Family BOIDÆ. ?

Genus DINOPHIS Marsh.

Dinophis littoralis (Cope).

Palæophis littoralis Cope. Proc. Acad. Nat. Sci. Philad., 1868, p. 147 and 234. Also Trans. Am. Phil. Soc., vol. xiv, 1869, plate v, fig. 1.

Dinophis halidanus (Cope).

Palæophis halidanus Cope. Proc. Acad. Nat. Sci. Philad., 1868, p. 234. Also Trans. Am. Phil. Soc., vol. xiv, 1869, plate v, fig. 2.

Dinophis grandis Marsh.

Am. Journal of Science, 2nd Series, vol. xlviii, 1869, p. 397.

The occurrence of closely related species of large serpents in the same geological formation in Europe and America, just after the total disappearance in each country of *Mosasaurus* and its allies, which show such marked ophidian affinities, is a fact of peculiar interest, in view of the not improbable origin of the former type; and the intermediate forms, which recent discoveries have led paleontologists familiar with these groups to confidently anticipate, will doubtless at no distant day reward explorations in the proper geological horizon.

Yale College, New Haven, Conn., Oct. 25th, 1869.

ART. XLI.—*Discovery of a new Planet, the 109th;* by Dr. E. H. F. PETERS (in a letter to one of the Editors).

I WRITE to communicate the discovery made here on Saturday night, of a planet, the 109th of the asteroid group. It is in the constellation of *Pisces*, more properly in the following position:

1869, Oct. 9, $13^h\ 31^m\ 58^s$, Hamilton College mean time. A. R. $= 0^h\ 56^m\ 2{\cdot}60^s$. Decl. $= +9°\ 37'\ 10{\cdot}6''$.

Its motion in declination is almost nothing; that in right ascension over a minute per day. In brightness it equals a star of the 10th magnitude.

Litchfield Observatory of Hamilton College, Clinton, N. Y., Oct. 11th, 1869.

SCIENTIFIC INTELLIGENCE.

I. PHYSICS.

1. *Observations on the protuberances of the Sun.*—Zöllner has communicated to the Royal Society of Sciences of Saxony the results of observations of the solar protuberances made by a new method, the details of which are, however, not given in the paper from which this abstract is taken. The author states that by this method the protuberances can be observed with great sharpness and distinctness, and gives a number of figures of much interest, representing various forms of the red eruptive flames. The method of observation employed gives the same protuberance in three different colors at the same time, corresponding to the three homogeneous lines of the spectrum, red, yellow and blue. A marked difference is observed between the yellow and the other two images. The yellow image is very intense near to the edge of the sun's disc where it corresponds with the other images, while at a greater distance the finer details are lost. Zöllner infers from this either that the rays to which the yellow image is due proceed from a gas specifically heavier than hydrogen and, therefore, occupying a lower stratum, or that the increase in the temperature and pressure of the hydrogen near the surface of the sun determines the emission of the yellow rays in question. The author remarks that the red protuberances, as seen by his method, for the most part strongly resemble the various forms of terrestrial clouds, the cumulus type being most distinctly exhibited. There are, however, some exceptions; in certain cases the phenomena resemble those of eruptions of volcanoes or of hot springs. Zöllner suggests that it may hereafter be possible to observe at the same time all the protuberances as in the case of a total eclipse. In conclusion the author mentions another observation of great interest. On the 27th June the slit of the spectroscope was made to approach a part of the sun's disc where the spectral lines of the protuberances were particularly long and bright. At a distance of 3 or 4 minutes above the sun's edge the whole length of the spectrum was crossed by bright linear flashes. These flashes extended over the whole portion of spectrum in the field of view and were so abundant at one point of the sun's edge that it seemed as if the whole spectrum were crossed by the straight paths of rapidly following electric discharges. This phenomenon would be explained by the assumption that small intensely ignited bodies are moving near the sun's surface and sending out rays of all refrangibilities. As the images pass rapidly before the slit of the spectroscope they give a spectrum with flashing lines.—*Pogg. Ann.*, cxxxvii, 624, No. 8, 1869. W. G.

2. *On a method of viewing the solar prominences without an eclipse.*—Mr. Huggins has also given a method of observing a solar prominence with a spectroscope. This method consists in placing a narrow slit behind the train of prisms before the object glass

of the observing telescope. This slit limited the light entering the telescope to that of the refrangibility of the part of the spectrum near C. The slit of the spectroscope was then inclined sufficiently to admit the form of the prominence to be seen. The spectrum became then so impure that the prominence could not be distinguished. A piece of deep ruby glass was then introduced so as to absorb light of all refrangibilities differing much from that of C. The prominence was then distinctly seen. When the sky is very clear the colored glass may be dispensed with.—*Proceedings of the Royal Society*, No. 109, 1869. W. G.

3. *Researches on gaseous spectra in relation to the physical constitution of the Sun, Stars and Nebulæ.*—FRANKLAND and LOCKYER have entered upon a special study of the spectra of several gases and vapors, with a view to throw light on the discoveries recently made bearing upon the physical constitution of the sun. In the first place, as regards hydrogen, the authors have as yet failed to detect any line in the hydrogen spectrum corresponding to the yellow line near D, (which might be conveniently denoted by *d*. W. G.), but the experiments are not yet complete. The thickening of the line F proves to be due to pressure and not appreciably, if at all, to temperature *per se*. The authors believe that there is ample evidence that in the higher prominences the gaseous medium is in a state of excessive tenuity, and that at the lower surface of the chromosphere itself the pressure is very far below the pressure of the earth's atmosphere. As the bright line *d* does not appear reversed in the solar spectrum, it follows that, assuming the line to be a hydrogen line, the selective absorption of the chromosphere is not sufficient to reverse it. Frankland and Lockyer remark that the facts observed lead to important modifications of the received theory of the physical constitution of the sun—that proposed by Kirchhoff. According to this theory the photosphere is either solid or liquid, and is surrounded by an atmosphere composed of the gases and vapors of the substances incandescent in the photosphere. Instead of this we find that the outer atmosphere consists mainly of hydrogen and that the photosphere is cloudy or gaseous or both. Thus it has been shown that a gaseous condition of the photosphere is consistent with its continuous spectrum; that the spectrum of the photosphere contains bright lines when the limb is observed, indicating an outer gaseous shell; that a sun spot is a region of greater absorption, and that occasionally photospheric matter appears to be injected into the chromosphere. These facts seem to show that the selective absorption which reverses the bright lines takes place in or near the photosphere. Other and more recently obtained results are as follows:

I. The Fraunhofer line of the solar spectrum named *h* by Angström, which is due to the absorption of hydrogen, is not visible, in the tubes, we employ, with low battery and Leyden jar power; it may be looked upon therefore as an indication of relatively high temperature. As the line in question has been seen by one of us reversed in the spectrum of the chromosphere, it follows that the

chromosphere, when cool enough to absorb, is still of a relatively high temperature.

II. Under certain conditions of temperature and pressure, the very complicated spectrum of hydrogen is reduced in our instrument to one line in the green corresponding to F in the solar spectrum.

III. The equally complicated spectrum of nitrogen is similarly reducible to one bright line in the green, with traces of other more refrangible faint lines.

IV. From a mixture of the two gases we have obtained a combination of the spectra in question, the relative brilliancy of the two bright green lines varying with the amount of each gas present in the mixture.

V. By removing the experimental tube a little farther away from the slit of the spectroscope, the combined spectra referred to in II and III were reduced to the two bright lines.

VI. By reducing the temperature all spectroscopic evidence of the nitrogen vanished; and by increasing it, many new nitrogen lines make their appearance, the hydrogen line always remaining visible.

The authors infer that the temperature of the nebulæ is lower than that of our sun and that their tenuity is excessive. In a previous communication the authors stated that when the vapors of magnesium are injected into the chromosphere the spectral lines do not all attain the same height. Thus the heights of b, b^1 and b^2 are almost the same, but b^4 is much shorter. They now find that when the spark is made to pass in air between two poles of magnesium separated in such a manner that the magnesium spectrum does not extend from pole to pole, but is only visible for a small distance indicated by an atmosphere of magnesium around each pole, the magnesium lines b behave exactly as they do in the sun. The most refrangible of the three lines is the shortest while other lines, not yet discovered in the spectrum of the chromosphere, are still shorter. The authors consider this experiment as fully justifying their assumption that the mass of the absorption takes place in the photosphere and that this and the chromosphere constitute the true atmosphere of the sun.—*Proc. of the Royal Society*, vol. xvii, 288, 453. *Comptes Rendus*, lxix, 264. W. G.

4. *On the physical constitution of the Sun.*—In a letter addressed to M. Dumas and by him communicated to the Academy of Sciences, Mr. Lockyer has given a summary of his observations of the sun from which we extract the following table showing the lines observed in the chromosphere with the dates of their discovery.

Hydrogen.	
C	Oct. 20, 1868.
Near F	" "
D	Dec. 20, "
Near G	" "
M	March 14, 1869.

Sodium.	
D	Feb. 28, 1869.
Barium.	
1989·5 Kirchhoff's scale,	March 14, 1869.
2031·2 " "	July 5, 1869.
Magnesium.	
b 1, 2, 3, 4,	Feb. 21, 1869.
Iron 1474,	June 6, 1869.
? 1515·5,	" "
A brilliant ray 1529·5,	July 5, "
? 1567·5,	March 6, "
? 1613·8,	June 6, "
Iron 1867·0,	June 26, "
A brilliant line 1871·5,	" "
Iron 2001·5,	" "
? 2003·4,	" "
? Band or lines 2054·0,	July 5, "

—*Comptes Rendus*, lxix, 121. W. G.

5. *On the ultra violet Spectra.*—Mascart has examined the spectra of metals with special reference to lines beyond H, employing photography as a means of recording his observations. In this manner he has detected more than 100 new coincidences of iron and solar lines, in addition to the 450 observed by Angström in the visible spectrum. No coincidences could be observed with certainty for cadmium, though six very intense rays appeared also to exist in the solar spectrum. Mascart further calls attention to the occurrence, in different parts of the spectrum, of similar groups of lines belonging to the same element. Thus he observed in 1863 that the six principal rays of sodium observed by Wolf and Diacon are all double, and that the two rays of each group are at about the same distance as those of D. Magnesium, as is well known, gives the group of 3 rays *b*. In the ultra violet spectrum of the same metal there are two other remarkable groups. One, situated near L, can be seen by the eye without difficulty. It consists of 3 rays disposed in the same manner and at about the same distances as the three lines in *b*. These rays also exist in the solar spectrum. The other group is situated between P and Q and is also found in the solar spectrum. It has the same form as *b* but the rays are rather more widely separated. The wave lengths of the least refrangible rays in the three groups are respectively 518·2, 386·4 and 333·5. The author thinks that this repetition of the same phenomenon in different parts of the spectrum cannot be the result of chance, but depend on the molecular constitution of the luminous gas.—*Comptes Rendus*, lxix, 337. W. G.

6. *On the spectrum of the Aurora Borealis.*—In our notice of the spectral lines of the aurora borealis of April 15, 1869, given on p. 123 of vol. xlviii of this Journal, it is stated that 5 lines were seen. For 5 we should read 7, the places on Mr. Huggins' scale being

1280 brightest
1400
1550
1680
Near F
2640
Near G

We are indebted for this correction to Mr. Charles S. Peirce by whom the observations were made.

The brightest line is fully 20 times as bright as any other. The faint lines should perhaps be called bands rather than lines as they exhibit an appreciable breadth. On June 6th 5 lines were seen, the brightest being 1280 of Mr. Huggins' scale. W. G.

7. *On a new element associated with Zirconium.*—The existence of absorption bands in the spectra obtained from light transmitted through certain specimens of zircon was first observed by Prof. Church in 1866 and a notice of his results published in the Intellectual Observer, vol. ix, p. 291. The same bands have been recently observed independently by Mr. H. C. Sorby, who has inferred from them the existence of a new element to which he gives the name of jargonium. The natural silicate of jargonium is almost, if not quite, colorless but gives a spectrum exhibiting more than a dozen narrow black lines more distinct than even those of didymium. The borax bead gives no absorption bands, but by flaming crystals of borate of jargonia are formed, and the spectrum then shows four absorption bands unlike those of any other known substance. Another remarkable property of jargonia is that its compounds may exist in three different crystalline states, giving three wholly different spectra. The spectrum of the borax bead after flaming may easily be seen with the spectrum microscope which thus enables us to detect less than one per cent of jargonia in zircons. The spectrum, however, is different according to the temperature to which the bead has been subjected. Jargons from Ceylon of density 4·70 contain very little jargonia, but those of density 4·20 contain about 10 per cent, in a form which gives hardly a trace of absorption bands. On keeping such a specimen for some time at a high red heat the density increases to 4·60. The mineral then gives a spectrum with 13 narrow black bands and one broader line. No such changes occur with zircons from Miask which are free from jargonia. Mr. Sorby and Mr. David Forbes have both succeeded in making an approximate separation of jargonia by purely chemical methods, but their results must be considered only as first attempts and necessarily very imperfect.—*Proc. of the Royal Society*, xvii, 511. W. G.

8. *Additional observations on Hydrogenium.*—When a palladium wire is allowed to occlude hydrogen its length increases and from the corresponding increase in volume Graham determined the density of the occluded hydrogen to be about 2. It is now found, however, that the wire after the expulsion of the hydrogen undergoes a permanent shortening about equal in amount to the

previous elongation. If we assume that the volume added to the wire is represented by both the elongation and contraction the mobility of the palladium particles being determined by the first entrance of the hydrogen, the volume of the hydrogen in the alloy will rise from 4·68 per cent to 9·36 per cent and the density of hydrogenium will fall from 1·708 to 0·854, according to the new calculation. In another experiment the density was found to be 0·872. The alloys of palladium with other metals are also found to absorb hydrogen when the second metal does not much exceed one half of the mixture. The alloys all expand by the absorption and afterward contract but only to the original length of the wire. The following table gives the results of the author's determinations of the density of hydrogenium as deduced from different alloys:

	Density of hydrogenium.
When united with palladium alone,	0·854 to 0·872
" " and platinum,	0·7401 to 0·7545
" " " gold,	0·711 to 0·715
" " " silver,	0·727 to 0·742

The mean of these numbers is 0·733 which may be accepted provisionally as the approximate density of hydrogenium.—*Proc. of the Royal Society*, vol. xvii, p. 510. W. G.

9. *On the properties of fluohydric acid.*—We extract from an extended memoir by Mr. G. Gore, the following account of the properties of pure fluohydric acid, as obtained by heating perfectly dry fluohydrate of fluorid of potassium in a platinum retort. The pure acid at 15·5° C. is a colorless mobile liquid; its density is 0·9879 at 12·7° C., water at the same temperature being taken as 1; it boils at 19·4° C. and remains fluid at −34·5° C. The acid is a most dangerous substance to handle, requiring the utmost care. Dry gaseous fluohydric acid does not attack glass so long as moisture is completely excluded.—*Proc. Royal Society* xvii, p. 256.

W. G.

10. *On a new mode of formation of the nitro-prussids.*—When potassic cyanid is added to a solution of a ferrous salt an orange colored precipitate, as is well known, is formed. Städeler finds that this precipitate has the formula Fe_2Cy_5K, and that with potassic nitrite it yields, on boiling, potassic nitro-prusside, ammonia and ferric oxyd. The equation representing the reaction is here—

$$Fe_2Cy_5K + N\Theta_2K = Fe\Theta + Fe(N\Theta)Cy_5K_2.$$

The ammonia in this case results from the action of the ferrous oxyd upon potassic nitrite, and is, therefore, with ferric oxyd to be regarded as a secondary product. After a careful discussion of the whole subject Städeler arrives at the conclusion that Gerhardt's formula for sodic nitro-prusside is correct; and it therefore contains nitroxyl ($N\Theta$) and not ($N\Theta_2$) as others, and in particular Hadow, had maintained. Städeler agrees with Playfair in deriving the nitro-prussides from a hitherto unknown ferrocyanhydric acid $FeCy6H_2$ which may be termed superferrid-cyanhydric acid. The potassic salt of this acid appears to be formed by the action of

iodine upon ferrid-cyanid of potassium and Städeler promises a further investigation of the subject.—*Ann. der Chemie u. Pharmacie*, lxxv, 1. W. G.

11. *Researches on Vanadium.*—Roscoe has continued his fine investigation of the compounds of vanadium and in the second part of his paper describes vanadium itself and three of its chlorids. Vanadic tetrachlorid is a dark reddish brown volatile liquid obtained when metallic vanadium or the mono-nitrid is burned in chlorine; its density at 0° C. is 1·8584; it does not solidify at −18° C., is decomposed on boiling and even at ordinary temperatures into trichlorid and free chlorine. Water decomposes the tetrachlorid into chlorhydric acid and a blue solution of the tetroxyd V_2O_4. The tetrachlorid does not combine with bromine. Vanadic trichlorid crystallizes in beautiful peach blossom colored scales closely resembling chromic sesquichlorid. It is not volatile in hydrogen, but first loses an atom of chlorine, forming the dichlorid, and afterward, at a higher temperature, loses all its chlorine, leaving the metal as a gray lustrous powder. It is very hygroscopic and deliquesces to a brown liquid. The density of the trichlorid is 3·00 at 18° C. Vanadic dichlorid is also a solid, crystallizing in bright apple-green micaceous plates. It is extremely hygroscopic; when thrown into water a violet colored solution is formed like that of hypovanadous acid and bleaching strongly by reduction. Metallic vanadium, prepared by reducing the dichlorid in hydrogen at a red heat, is a brilliant crystalline metallic mass having a bright silver-white lustre. It does not oxydize or tarnish in the air at ordinary temperatures or even when heated in air to 100° C. When heated quickly in oxygen it burns vividly forming the pentoxyd; but when slowly ignited in air it first forms a brown oxyd, perhaps V_2O, then the black trioxyd, the blue tetroxyd and finally the pentoxyd. The density of the metal at 15° C. is 5·5; it is insoluble in hot or cold chlorhydric acid; strong sulphuric acid dissolves it on heating, giving a yellow solution; fluohydric acid dissolves it slowly with evolution of hydrogen; nitric acid of all strengths acts violently, evolving red fumes and yielding a blue solution. Metallic vanadium burns when heated in a current of chlorine forming the tetrachlorid; heated in a current of nitrogen the mono-nitrid is formed.—*Chemical News*, vol. xx, 37, 38. W. G.

12. *On a new apparatus for the measure of the thermic expansion of solids.*—Prof. J. Müller has made an application of Poggendorff's mirror-arrangement to the measurement of the expansion of solids. The apparatus used for the purpose is described in full, and the details of a measurement in the case of an iron bar are given.—*Pogg. Ann.*, cxxxv, 672. W. G.

Note.—It is not a little remarkable that neither Prof. Müller nor the distinguished editor of the Annalen should be aware of the fact that the above mentioned instrument is not new either in principle or in application. The reflecting pyrometer was invented in 1826 by Mr. Saxton, now of Washington, D. C., and used by him

in adjusting the compensation of a pendulum. It is however first mentioned in print in Prof. Bache's reports on Weights and Measures for 1846 and 1848, and fully described and figured in the report for 1856. It is referred to as having been used to compare the measuring bars for the base-lines in the Coast Survey Report for 1847 and again more particularly in that for 1854, in which the base-measuring apparatus is described and figured. The actual publication from which according to established usage the invention of Mr. Saxton must date is 1856. It is scarcely necessary to say that this note is not intended to dispute Prof. Müller's originality and independence in the invention, but only to assert the prior claims of another. W. G.

13. *On a new Acid of Sulphur.*—Some years ago Schönbein noticed that when an aqueous solution of sulphurous acid is acted upon by zinc for a few moments, it becomes yellow in color, and acquires the property of decolorizing energetically solutions of indigo and litmus. He supposed ozone to be in some way formed, and to act as the bleaching agent. This interesting reaction has been recently studied by SCHÜTZENBERGER, who argued that since the indigo and litmus solutions, thus bleached, regained their color on exposure to the air, the decolorization must be due to a reduction rather than to an oxydation; and since the liquid possessed its activity even after separation from the zinc, the effect could not be due to a simultaneous action of the acid and zinc, but must result from the production of some new and energetic reducing body, which it would be possible to isolate. His preliminary experiments showed him: 1st, that the formation of zincic hyposulphite takes place only after the bleaching power has passed its maximum; 2d, that cupric sulphate gives with the yellow reducing liquid, a precipitate of cuprous-hydrid, which, when the copper salt is in excess is mixed with metallic copper; 3d, that salts of silver and mercury are likewise reduced by this reagent; 4th, that the maximum decolorizing power of the liquid, measured by means of a titred potassic permanganate solution is one and a half times that of the sulphurous acid solution, before putting in the zinc; 5th, that the zinc may be replaced by iron, by manganese, or by magnesium with the same results; and 6th, that no hydrogen is set free during the solution of the zinc in the acid. He observed further, that the effect is immensely increased when a concentrated solution of hydro-sodic sulphite (bisulphite of sodium) is used in place of sulphurous acid, the zinc being in the form of turnings, and the mixture being artificially cooled, the entire operation being conducted out of contact with the air. In half an hour the reaction is finished, and crystals of sodio-zincic sulphite are deposited. The decanted liquid instantly bleaches blue litmus paper, which, on exposure to the air, regains its color, becoming red. By contact with the air, the liquid also loses its properties, and then contains only sodio-zincic sulphite and hydro-sodic sulphite. The zinc turnings left after the decantation, become heated to 55° or 60° C. by the oxydation of the

adhering liquid, evolving visible vapors; the filter too, becomes sensibly hot. The strong attraction of the new body for oxygen is thus very evident. The following is Schützenberger's method for isolating the compound thus active: about half a liter of the active liquid just described, is poured into a flask of two liters capacity, two-thirds filled with strong alcohol, which is then tightly corked. At first, a crystalline deposit is thrown down, composed of the double sulphite mixed with the new product. The clear alcoholic liquid is decanted into a flask, which it should completely fill; this is well closed, and placed in a cool room. In a short time it becomes almost a solid mass of fine colorless needles. These are thrown upon a cloth and rapidly expressed; the solid matter thus retained, though small in amount, is the active substance, the expressed liquid being entirely inactive. Since this crystalline mass heats at once on exposure to the air, it must be immediately placed in the vacuum of an air-pump. On drying, the crystals fall into a white powder permanent in the air, which is soluble in water and dilute alcohol, but insoluble in strong alcohol. It contains a trace of zinc, evidently from admixture with sodio-zincic sulphite, since the impurity may be removed by recrystallization. After oxydation, the powder consists only of hydro-sodic sulphite. Before oxydation its solution decolorizes strongly sulphate of indigo and litmus, precipitates cuprous hydrid from the sulphate, and metallic silver from the nitrate. It has a hot taste, recalling that of hydro-sodic sulphite. Dried in a vacuum and heated in a tube, it gives off a little water, sulphur, and sulphurous oxyd, and leaves a residue of sodic sulphate and sulphid. The numbers obtained on an analysis agree very closely with those given by hydro-sodic sulphite.* And Schützenberger believes that the evolution of water and sulphur during the calcination of the dry salt, shows that this body contains feebly-combined hydrogen which acts as if it were nascent, and thus makes the body active. He maintains that the compound obtained above, is the soda salt of a peculiar acid analogous to hypophosphorous, less oxygenated than sulphurous, and writes its formula $\left.\begin{matrix}S\Theta,H\\Na\end{matrix}\right\}\Theta$, that of hydro-sodic sulphite being $\left.\begin{matrix}(S\Theta)''\\HNa\end{matrix}\right\}\Theta_2$.† Of course the corresponding acid would be $\left.\begin{matrix}S\Theta H\\H\end{matrix}\right\}\Theta$. It is much less stable than its sodic salt, and its formation by the action of the sulphurous acid upon zinc is as follows:

$$(H_2S\Theta_3)_2+Zn=Zn\,S\Theta_3+S\Theta H.H\Theta+H_2\Theta.$$

* [The original statement is: "L'analyse de ces cristaux secs a donné des nombres qui se rapprochent beaucoup de ceux que donnerait le bisulfite anhydre de soude." If this be true, then the formula given cannot be correct. Theory however, would confirm the formula, and look for a qualification of the analytical statement. —G. F. B.]

† [By an evident misprint, this formula is given twice as $\left.\begin{matrix}SO\\HNa\end{matrix}\right\}O$, and once it is called "bisul*fate* de sodium"! So also zincic sulphite is twice printed $(SO_3)_2$ Zn, instead of SO_3Zn; and this error uncorrected, vitiates both the equations in which it occurs.—G. F. B.]

The acid may also be obtained by adding very dilute sulphuric acid, (1 molecule in a liter) to the sodic salt. A beautiful deep orange-yellow liquid, having an intense bleaching power is produced, which soon becomes turbid from the setting free of sulphur, and loses its activity. The decolorizing power of the liquid after the action of the zinc, as measured by permanganate solution, was found to be exactly one-third greater than that of the hydro-sodic sulphite originally:

$$(HNa\,S\Theta_3)_2 + Zn = Na_2\,S\Theta_3 + Zn\,S\Theta_3 + S\Theta H.\,Na\Theta + H_2\Theta.$$

Taking the bleaching power of one molecule of $S\Theta_2$ as unity, and excluding the zinc, the first member of the above equation contains three decolorizing units, the second (by experiment) contains four, an increase of one-third. This accords with the previous statement in regard to the liquid obtained by the action of zinc upon sulphurous acid. The reaction is:

$$(H_2S\Theta_3)_2 + Zn = Zn\,S\Theta_3 + S\Theta H.H\Theta + H_2\Theta.$$

In this case there are two units of decolorizing power in the first member, and three in the second, an increase of one-half as above stated.

Because of the composition and the mode of formation of this acid, Schützenberger proposes to call it *hydro-sulphurous acid*, and its sodic salt, *sodic hydrosulphite*. He has produced it by the action of iron, manganese, and magnesium on sulphite solutions, and, what is more remarkable, by the electrolysis of hydro-sodic sulphite. The nascent hydrogen evolved from the negative electrode—the only one immersed in the solution—being absorbed by the sulphite which becomes hydrosulphite. He finds indeed that when a solution of hydro-sodic sulphite is used in the porous cup of a Bunsen cell, a current is produced but little inferior to that given by nitric acid, and of much greater constancy.—*Bull. Soc. Ch.*, II, xii, 121, August, 1869. G. F. B.

14. *On the use of Thallous oxyd as a test for Ozone.*—In March, 1868, Schönbein proposed to use thallous oxyd as a test for ozone. He impregnated paper with some thallous solution, and exposed it to an atmosphere containing ozone, when the paper became brown from the production of thallic oxyd. Pure oxygen, and air free from ozone were said to be without action. Inasmuch as it was said to remain unaffected in presence of nitrous fumes, it would be invaluable as a test for ozone, if shown to be reliable. For this purpose Lamy undertook an investigation into the relations of ozone to the oxydation of thallium. During an entire year he made numerous comparative experiments with two different kinds of the test-paper, exposing them under the most diverse conditions. In Paris they were placed in the boulevard St. Michel, facing the garden of the Luxembourg; in the open country, they were carried to the Jura, and lastly they were exposed in some of the northern chemical works. The results of these experiments are given as follows: 1st, Thallous oxyd turns brown without being exposed to ozonized air or oxygen; 2d, the sensitiveness of thallous oxyd paper varies

with the degree of concentration of the solutions with which it is prepared, and also with the amount of carbonate present in them; 3d, recently prepared thallous oxyd paper appears to be more sensitive to the oxydizing action of ozone than iodid of starch paper; 4th, the more or less deep coloration of the thallium papers is a certain sign of the presence of ozone only when they are able to turn guaiacum tincture blue; 5th, within the conditions now given, thallous oxyd papers may be used to detect with certainty and rapidity the presence of ozone, even in the midst of a strongly nitrous atmosphere; their employment, however, should be limited to simple confirmations of the presence of ozone, and not extended to a determination of the amount of active oxygen present.—*Bull. Soc. Ch.*, II, xi, 210, March, 1869. G. F. B.

15. *On the preparation of concentrated Iodhydric acid.*—The extensive demand for a concentrated solution of iodhydric acid in the laboratory, particularly as a reducing agent in organic research, has induced VIGIER to make some experiments upon its economic preparation. He employed the usual method, acting upon red phosphorus by iodine in presence of moisture, the operation being conducted in a tubulated retort whose neck was prolonged by a recurved tube, so that the gas as evolved, could be made to pass into a bottle containing distilled water and kept cold by ice. As to the relation between the amounts of phosphorus and iodine used, Vigier finds that for every 1 part of phosphorus, 20 parts of iodine and 15 parts of water are required. An excess of iodine does no harm; but if the phosphorus be used in a less proportion than this, the phosphorous acid formed from the action of water upon the phosphorous iodid, breaks up under the influence of the heat into phosphoric acid and phosphine, PH_3, which phosphine unites directly with the iodhydric acid gas to form phosphonium iodid PH_4I, which condenses in beautiful crystals in the cooler parts of the tube, and may completely close it. The retort is placed in water to keep it cool, the necessary quantity of phosphorus, iodine and water, in the proportions above given, is placed within it—the iodine being added gradually,—and the whole is exposed to a gentle heat, the receiver being kept cool by ice. On repeating the charge, the partially saturated solution of the acid is to be used in place of water. In concluding the operation, the retort may be placed on a sand-bath to expel the last traces of the iodhydric acid gas.—*Bull. Soc. Ch.*, II, xi, 125, Feb., 1869. G. F. B.

16. *A new series of Platinum Compounds.*—SCHNEIDER has studied the action of stannous chlorid upon the salts of platinum. He finds that when a freshly prepared solution of stannous chlorid, moderately concentrated, and containing free hydrochloric acid, is poured into a solution of platinic chlorid, containing 0·01 grm. platinum, the fluid is colored at first dark yellow, then bright brown, and finally becomes so dark brown as to be opaque. If the stannous chlorid be added carefully and in small portions so long as each addition increases the depth of color produced, it will be found that nearly three molecules of the tin salt will be re-

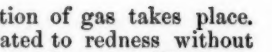
quired for every one of the platinic chlorid. If sufficient acid be present, the fluid remains clear, even on dilution with water. After standing twelve hours in a well closed vessel, the dark brown fluid is cautiously neutralized with ammonia, when there separates a voluminous dark brown, almost black, precipitate, leaving the supernatant fluid colorless. The reaction of the tin salt upon the platinic oxyd, Schneider gives thus:

$$(PtO_2)_2 + (SnO)_6 = Pt_2O + (Sn_2O_3)_3.$$

He views the above precipitate as a compound of the stannoso-stannic oxyd with a hypo-platinous oxyd, containing only half as much oxygen as the platinous compound. That such a stage of oxydation exists, he proves by finding that a platinum solution, reduced by sulphurous acid to the platinous condition, affords the same brown precipitate on the addition of stannous chlorid and treatment with ammonia. On drying this dark brown precipitate over sulphuric acid, it appears as a brilliant brittle mass, easily rubbed to a black-brown powder. On heating in the air, it at first loses some water, but then undergoes no alteration by heating to redness. Heated in a stream of hydrogen, water is given off, and a mixture of metallic tin and platinum is left. In composition it varies slightly, according to the strength of the solutions employed. A carefully prepared specimen afforded on analysis 29·10 Pt, 57·05 Sn, 13·85 O; the above formula, $Pt_2Sn_6O_{10}$, requires 31 per cent Pt, 56 Sn, and 13 of O, a very close approximation. Schneider suggests that this compound has an analogy with the purple of Cassius, and proposes for it the name stanno-platinous stannate. If it be treated while still moist with a very dilute sodic hydrate solution, the greater part of the stannic oxyd is taken up, and a black, pretty dense powder is left, which after repeated treatment with soda, always contains tin. A mean of several analyses gave its composition as follows: 50·0 per cent of Pt, 29·3 of Sn, 6·0 of Na, and 13·5 of O, leading to the formula $Na_2Pt_2Sn_2O_6$, a sodio-platinous stannate. From the stanno-platinous stannate as a starting point, a series of interesting compounds has been made.—*Pogg. Ann.*, cxxxvi, 105, January 27th, 1869.

G. F. B.

17. *Potassio-platinic oxysulphoplatinostannate.*—On fusing together an intimate mixture of 4 parts stanno-platinous stannate, 6 parts pure potassic carbonate, and 8 to 10 parts of sulphur in a covered crucible, and treating the cooled mass with water, the greater part dissolves, giving an intense brown solution, while there remains a cochineal-red crystalline powder, which may be obtained pure by washing with water, in which it is insoluble. Similar crystals are obtained by fusing the stannate with liver of sulphur, or by fusing together 6 parts spongy platinum, 3 parts stannic sulphid, 12 parts potassic carbonate, and 12 parts sulphur, and then extracting with water. Under the microscope the crystals are very beautiful, being six-sided tables, dark garnet-red in color, and having an almost metallic luster. Treated with hydrochloric acid, the color of the powder changes to gray, the potas-

sium being removed as chlorid; no evolution of gas takes place. Out of contact with the air, it may be heated to redness without change. On analysis it yielded: Pt 59·47, Sn 11·86, K 7·76, S 19·35, O 1·79, giving the formula $K_2Pt_3SnS_6\Theta$. Schneider discusses pretty fully the decompositions observed, and from them concludes that the rational formula is  . A similar compound of sodium has also been prepared. Analogous bodies of the series the author promises to describe in a future communication.—*Ibid.* G. F. B.

18. *On Potassic and Sodic Ethylates.*—When any one of the alkali metals acts upon alcohol there is formed a body called an ethylate. If sodium be the metal used, crystals are after a time formed which have hitherto been supposed to be pure sodic ethylate, but which according to Geuther and Scheitz, are really a compound of this body with alcohol. Wanklyn has re-examined this substance and finds it to be composed of one molecule of sodic ethylate and three of alcohol, $Na(\mathrm{C_2H_5})\Theta$, $(H(\mathrm{C_2H_5})\Theta)_3$. It fuses at 100° C. without decomposition, and remains colorless so long as the air is excluded, a very slight exposure to the atmosphere turning it brown. It is scarcely soluble in ether, more soluble in a mixture of acetic ether and ether. On heating this compound in an oil bath to 190° or 205° C., the alcohol is completely expelled and pure sodic ethylate is left, as was proved on analysis, all the sodium being found caustic. Absolute sodic ethylate is a perfectly white amorphous solid, non-fusible, and very light, floating on ether. It is nearly insoluble in ether and may be heated in close vessels to 275° C. without losing its whiteness. It is one of the most stable of organic compounds, suffering a temperature of 290° C. without decomposition. At dull redness, it carbonizes, evolving marsh gas and hydrogen, probably. The residue contains sodic hydrate and carbonate, with some free sodium. On treating sodic ethylate with acetic ether, an interesting isomer of sodic butyrate is produced which Wanklyn formulates thus: $(\mathrm{C_2H_4})Na'''\Theta(\mathrm{C_2H_3}\Theta)$. Potassium gives a similar ethylate, which also forms a compound with alcohol.—*Phil. Mag.*, IV, xxxvii, 117, Feb., 1869. G. F. B.

19. *On a new radical, Ethylene-sodium, and its compounds.*—Wanklyn has subsequently more thoroughly investigated the isomer of sodic butyrate mentioned above. He is inclined to regard absolute sodic ethylate as the hydrate of a new radical which he calls ethylene-sodium. He therefore writes its formula $\left.\begin{matrix}(\mathrm{C_2H_4})''Na'''\end{matrix}\right)'$ $\left.\begin{matrix}\\H\end{matrix}\right\}\Theta$, and believes that by the action of a compound ether upon it, its hydrogen is replaced by the acid radical; so that for example, on treatment with acetic ether it gives ethylene-sodic acetate, $\left.\begin{matrix}(\mathrm{C_2H_4}Na)'\\(\mathrm{C_2H_3}\Theta)\end{matrix}\right\}\Theta$. The radical itself has not been obtained free, owing to the many difficulties in the way. In regard to its

chemical constitution, Wanklyn prefers the formula $((\mathrm{C_2H_4})'\mathrm{Na'''})'$, claiming the trivalent nature of sodium from the two compounds sodium-zinc-ethyl and sodium tri-acetyl, and regarding it as the analogue of nitrogen and arsenic, rather than of hydrogen. Beside the acetate, the valerate and benzoate of this radical, and the acetate and valerate of the homologous radical, amylene-sodium, have been prepared by Wanklyn.—*Phil. Mag.*, IV, xxxvii, 175, March, 1869. G. F. B.

20. *On some Acetyl compounds of the Carbohydrates.*—Schützenberger and Naudin have published the results of some interesting researches upon the carbohydrates. When cellulose, either in the form of cotton-wool or Swedish filtering paper, is heated to 180° in close vessels with six to eight times its weight of acetic oxyd (anhydrid) it dissolves to a thick syrup, which, when poured into water, deposits white flocks of triacetyl cellulose, $\mathrm{C_6H_7(C_2H_3O)_3O_5}$. These flocks are insoluble in water, alcohol and ether, are soluble in concentrated acetic acid, and are re-converted into cellulose by alkaline solutions. No higher acetyl compound can be obtained, either by longer heating or by any excess of the oxyd. The authors therefore conclude that cellulose is a triatomic alcohol. They formed also mono-acetyl and di-acetyl cellulose but were not able to obtain them free from each other. Starch, when heated to 140° in presence of an excess of acetic oxyd, swells up strongly, but does not dissolve. On washing the residue with water, a white amorphous mass is obtained, which is insoluble in water, alcohol, and *acetic acid*, and is not blued by iodine. Its composition is $\mathrm{C_6H_7(C_2H_3O)_3O_5}$, and it is decomposed by alkalies, yielding the starch again. If however, the mixture be heated to 160°, the porous mass dissolves, forming an amber-colored syrup, from which water precipitates a white amorphous substance, insoluble in water, alcohol, and ether, but *soluble in acetic acid*, and isomeric with the former. When acted upon by alkalies, it is converted into dextrin; it is therefore tri-acetyl dextrin. Neither starch nor dextrin will permit the substitution of more than three acetyl atoms; these bodies also, therefore, are triatomic alcohols. Inulin affords a tri-acetyl derivative, as also does gum arabic. In the case of the sugars, acetic oxyd attacks them energetically, but to obtain saturated compounds, it is necessary to heat them with an excess of acetic oxyd for twenty-four hours, to 170° in closed vessels. The reconversion into the sugars again, cannot be effected by alkalies, since the sugars are so easily decomposed by them; but it may be readily accomplished simply by heating with water to 160°. Dextrose (grape sugar), heated in open vessels with 2½ parts of acetic oxyd, reacted violently, and gave a solid, colorless soluble product, bitter in taste, and having the composition of di-acetyl dextrose. This, when heated with 2 parts acetic oxyd to 140°, afforded a second derivative, slightly soluble in pure water, but readily soluble in dilute acetic acid, alcohol, and ether, and having the formula $\mathrm{C_6H_9(C_2H_3O)_3O_6}$, tri-acetyl dextrose. Finally, if this compound be heated with a large excess of the oxyd, to 160° for 24 hours, a saturated compound is formed, similar to the last, but in

soluble in dilute acetic acid. If however, the fluid be poured into water, a tenacious precipitate is thrown down, which by washing in water, solution in alcohol, treatment with animal charcoal, and evaporation of the filtered solution, is obtained pure. Analysis gave it the formula $C_{12}H_{14}(C_2H_3O)_8O_{11}$. Saccharose (cane sugar) affords under similar conditions, a precisely similar saturated body. Lactose (milk sugar) also dissolves when heated with acetic oxyd to 140°, and affords a sticky mass, becoming soon pulverulent, having also the composition $C_{12}H_{14}(C_2H_3O)_8O_{11}$.

After giving the above facts in his Journal, FITTIG says in a note that these interesting results are in complete accordance with the view of the constitution of these bodies which he has for a long time held. All these carbohydrates are saturated derivatives from hexyl hydrid C_6H_{14}, coming directly from a seven-acid alcohol $C_6H_7(OH)_7$. This alcohol, because two of its hydryl atoms are united to one carbon atom, is not, probably, capable of existing. On attempting to prepare it, it would, just as in the case of the aldehyd-alcohols (for example, the alcohol $CH_3—CH\begin{cases}OH\\OH\end{cases}$, when set free from its well known acetic ether $CH_3—CH\begin{cases}C_2H_3OO\\C_2H_3OO\end{cases}$) decompose into water and its first anhydrid, $C_6H_7\begin{cases}O\\(OH)_5\end{cases}$. This substance is grape sugar (dextrose). As the conversion of mannite into mannitan ($C_6H_8(OH)_6$ into $C_6H_8\begin{cases}O\\(OH)_4\end{cases}$) shows, the polyacid alcohols are very easily converted into anhydrids. If now the grape sugar loses still more water, two results may take place: 1st, two molecules may together lose the water, yielding in this case the anhydrid $\begin{matrix}C_6H_7\begin{cases}O\\(OH)_4\end{cases}\\C_6H_7\begin{cases}O\\(OH)_4\end{cases}\end{matrix}$, which is cane sugar, milk sugar, etc.; or 2d, the molecule of water may be taken from a single molecule of dextrose, affording then the triacid alcohol $C_6H_7\begin{cases}O\\O\\(OH)_3\end{cases}$; this is starch, cellulose, etc. The numerous isomers in these groups are easily accounted for; they have their cause as it would seem, partly in differences in the structure of the hexyl radical no doubt, but chiefly in the variations in the mode of grouping of the O and the OH atoms. According to this view, the formula for the saturated compound from grape sugar, i. e., $C_{12}H_{14}(C_2H_3O)_8O_{11}$ is much more probable than the $C_6H_6(C_2H_3O)_4O_5$ which Schützenberger admits to be possible. If this be the true formula, then it appears that grape sugar by the loss of water, is converted into the saturated ether of cane sugar, a reaction which is very interesting.—*C. R.*, lxviii, 814. *Zeitschr. Chem.*, II, v, 264, May 15, 1869. G. F. B.

21. *On the relation of Amylene to oil of Turpentine.*—BAUER and VERSON have succeeded in obtaining from rutylene bromid, by treatment with an alcoholic solution of potassic hydrate, a considerable quantity of a fluid having a boiling point between 156° and 160°, and yielding on analysis the formula $C_{10}H_{16}$. They noticed that both diamylene and rutylene, but especially the former, absorb oxygen readily from the air, under precisely the same conditions as does oil of turpentine. Hence from this cause, as well as from the formation of compound ethers by the action of the alkaline solution, it was somewhat difficult to obtain a pure product. The new hydrocarbon $C_{10}H_{16}$ is a clear and brilliant liquid, possessing an odor strongly recalling that of oil of turpentine, which is especially noticeable after a short exposure to the air. It burns with a bright but smoky flame. Cooled to 17° C. the first drops of bromine let fall upon it combine directly without evolution of hydrobromic acid; but a larger quantity acts violently, evolving this gas abundantly. Iodine acts similarly, but less actively. Nitric acid oxydizes it violently, and fuming sulphuric acid dissolves it with a deep brown color. Aqueous, as well as gaseous hydrochloric acid, combines directly with it even in the cold, giving after treatment, a colorless liquid boiling at about 180°, and having the composition $(C_{10}H_{16})_2HCl$. No direct union with water could be effected. The authors believe this hydrocarbon to be identical with terebene.—*Ber. Ak. Wien*, lviii. *Zeitschr. Chem.*, II, v, 402, July 3, 1869. *Am. Ch. Pharm.*, cli, 52. G. F. B.

22. *On the products of the oxydation of Paraffin.*—GILL and MEUSEL have succeeded in oxydizing paraffin and in studying the products. The paraffin was recrystallized from CS_2 and then fused at 60°. Sulphuric and hydrochloric acids, even when concentrated, were without action upon it. Bromine in sunlight did not unite directly with it, but formed a substitution product. Hypochlorous acid had no effect on it. The authors place it therefore in the marsh gas series, rather than the ethylene series. Oxydation with chromic acid gave a large quantity of cerotic and acetic acids, with other members of the fatty acid series. Nitric acid gave cerotic acid, but also acetic, butyric, valeric, and œnanthic acids, in the distillate, and a mixture of succinic and anchoic acids in the retort.—*J. Chem. Soc.*, vi, 466, Nov., 1868. *Zeitschr. Chem.*, II, v, 65, Feb., 1869. G. F. B.

II. GEOLOGY.

1. *Geology of Tennessee*, by JAMES M. SAFFORD, A.M., PH.D., State Geologist, Prof. Nat. Sci. in Cumberland University, Lebanon, Tennessee. Published by authority of the General Assembly. 550 pp. 8vo, with a geological map of the State and several lithographic plates of fossils. Nashville, 1869.—In 1855, Prof. Safford published his first and only biennial Report on the Geology of the State, under the title of *A Geological Reconnoissance of the State of Tennessee.* His labors were continued during several

succeeding years, and he was prepared for a final report just before the breaking out of the recent war. He has since continued his investigations, and has, at last, issued the volume, as here announced. Prof. Safford is a faithful observer and able geologist. He has had under study a region unsurpassed for interest in the country, for its position between the north and south, and the east and west, and the great variety of its formations, especially the older, make it geologically a keystone State. Although there is much work yet to be done over the great area to give completeness to the survey, the volume is one of great importance, not merely to the State but to all interested in the geology of the continent. The author describes first the physical geography of the State, in which respect there are some remarkable features; and then passes to the geological structure and the successive formations; the minerals (including ores), and rocks, of special use; and finally the soils and agricultural features. On the question of the age of the "Orange Sands" he differs from Prof. Hilgard, who has an article on the subject on a preceding page of this volume, drawn from extensive examinations of the deposit over regions farther to the south. The plates contain figures of fifteen "new species" of fossil shells and corals, besides others described by Roemer, and several fossil leaves determined and part of them named by Lesquereux. The geological map of the State, which adds greatly to the value of this excellent report, is nearly three and a half feet long with a breadth (from north to south) of about nine inches, and is handsomely and effectively colored.

2. *Geological Survey of Ohio.*—The State Geological Corps of Ohio, Prof. J. S. Newberry, chief geologist, Prof. E. B. Andrews, Prof. Edward Orton, Hon. John H. Klippart and Mr. G. R. Gilbert, assistants, and Prof. T. G. Wormley, chemist, held a meeting on the 5th of October last for comparing and combining the results of the summer's work, and the day was occupied in this and in opening and examining the numerous packages of specimens forwarded to headquarters during the summer.

The survey was commenced on the first of June, with the following organization. Prof. J. S. Newberry, chief geologist; Prof. E. B. Andrews, Prof. Edward Orton and J. H. Klippart, Esq., assistant geologists.

In addition to these officers, appointed by the Legislature, ten additional assistants have been constantly employed on the survey during the last three months. Of these, all but two were volunteers, receiving only the payment of their traveling expenses for their services. The surveying party was divided into four detachments to whom different districts were assigned. Of these, two, operating in the northern half of the state, were under the immediate supervision of the chief geologist; another, under Prof. Andrews in the southeastern quarter, and still another under Prof. Orton in the southwestern quarter of the State.

The first duty assigned to the surveying party was to trace out the geographical extent of the different formations, so that an

accurate geological map could be made, and to gather material for settling the much debated questions of the relations of the rocks of Ohio to those of adjoining States. This part of the work is practically done. An accurate geological map, on a large scale has been made, the doubtful questions in the geology of Ohio definitely settled, and a large amount of interesting material gathered illustrative of our ancient flora and fauna, as well as of our mineral resources—coal, iron, salt, peat, gypsum, clay, water-lime, etc.

The detailed examination of the State by counties has also been begun and careful surveys of Washington and Perry counties have been made, or are in progress, by Prof. Orton, and of Cuyahoga and Erie counties by Prof. Newberry and his assistants.

The specimens already collected, filling more than fifty boxes, will form the commencement of a museum of economic and scientific geology in this city. Sets of specimens are also collected for the principal colleges in the State.

Prof. Newberry's first report will be presented to the Legislature in January next. Including, as it will, the records of the present half year's work and the result of twenty years geological study and collection in Ohio by Prof. N., it cannot fail to contain much interesting and valuable matter. For this report fifty plates are already drawn, and more than one hundred analyses of our useful minerals made at the private cost of the chief geologist. This report will also include special reports on the geology of certain counties, and of regions of peculiar importance as mining and manufacturing.—*Ohio State Journal, Oct.* 6.

The results which have already been obtained prove the connection and equivalence of the Waverly with the Vespertine of Rogers, thus showing that the Waverly is Lower Carboniferous, and settling this vexed question.

3. *Earthquake in New England.*—On the morning (about 6 o'clock) of Friday the 22nd of October last, an earthquake was felt over New England from Connecticut northeastward to Maine, and beyond over New Brunswick and Nova Scotia. It was slight at New Haven and noticed by but few. But at St. John, N. B., the shock was severe, lasted about twenty seconds, and was preceded by a rumbling noise. It is stated that houses were shaken, and many left them from alarm. At Fredericton and other places in New Brunswick, chimneys were thrown down and the walls of houses cracked. In Nova Scotia, it was felt in Halifax, Annapolis and Kentville.

4. *Synthetic Experiments relative to Meteorites;* by M. Daubrée.—Prof. Daubrée has published several papers on the origin of meteorites as illustrated by experiments for the production of the same material in its different meteoric conditions, and has embodied his views in a work of 68 pages, published at Paris in 1868.* The results are of the highest importance to geology as

* Expériences synthétiques relatives aux Météorites; rapprochements auxquels ces expériences conduisent, par M. A. Daubrée, Membre de l'Institut, Inspecteur Gen. des Mines, etc. 1868.

well as to the special department of meteorites; and we are gratified to state that a translation of it has been published in the Report of the Smithsonian Institution for 1868, recently issued.

5. *Substances Minérales*, par A. DAUBRÉE, Membre de L' Institut, Inspecteur Gen. des Mines: one of the "Rapports du Jury International," publiés sous la direction de M. Michel Chevalier. 266 pp. 8vo. Paris, 1867.—This report by the able mineralogist and geologist, A. Daubrée, treats especially of the useful mineral and rock materials that were exhibited at the Paris Exposition of 1867, taking up the subject in the following order: Combustibles; Bitumines; Ores of iron; Ores of other metals; Minerals useful in the chemical arts; Ornamental stones; other useful minerals; collections of rocks, minerals and ores. Under these heads, the materials from the different countries represented are taken up in succession, and along with the descriptions, there are also general remarks on the mines and their productions for each country and for its several mining regions, together with observations of historical, economical and geological interest. The volume is a valuable collection of facts pertaining to many of the mines and useful minerals of the world.

III. ZOOLOGY.

1. *Critical remarks on the Halcyonoid Polyps with descriptions of new species in the Museum of Yale College. No. 4;* by A. E. VERRILL.—Through the kindness of Dr. Albert Kölliker we have recently received a large collection of spicula, prepared by him from authentic and original specimens in various European museums, including many of the types of species described by Esper, Lamarck, Valenciennes, Edwards and Haime, Duchassaing and Michelotti, Mobius, etc. From an examination of these and other species, I am led to make the following observations, relating mainly to genera and species alluded to by me in former articles.

LEPTOGORGIA (sens. mod.) Edwards and Haime, Corall. i, p. 163= Leptigorgia (pars), Gorgonia (pars), Rhipidogorgia (pars), Gorgonella (pars), Verrucella (pars), Pterogorgia (pars), and Lophogorgia Edw. and Haime,=Gorgonia (pars) Kölliker, Icones Hist., ii, p. 139,=Litigorgia Verrill, this Journal, xlv, p. 414, 1868, and Trans. Conn. Acad., i, p. 387. 1868.

In the work of Edwards and Haime the name, *Leptogorgia*, was applied to an incongruous group, comprising 14 nominal species, having scarcely any thing in common, except the slenderness of the branches, lack of prominent cells, and a somewhat thin cœnenchyma. As thus constituted it included representatives of at least five genera, while many species having the closest relations with the more typical species were scattered through several other genera, including even *Gorgonia*. Hence in former articles I proposed two new names for genera, part of the species of which would have been included by Edwards and Haime under *Leptogorgia*. At that time I had not examined several of the species referred by

them to *Leptogorgia*, including the first species, *L. viminalis*, which may be regarded as most typical. Having received from Dr. Kölliker spicula from the original specimen of this and several other species in the Paris Museum, I have found that *L. viminalis* of Edw. and Haime is a *Litigorgia*. The same is true of their 4th species, *L. rosea;* the 7th, *L. Webbiana;* 8th, *L. viminea;* 11th, *L. virgulata;* 13th, *L. virgea*. Their 3d and 10th species belong to our *Gorgonia: G. miniacea* (Esp. orig.) and *G. sanguinea* (Lamk. orig.). The 9th is an *Echinogorgia* (*E. aurantiaca*) and *Gorgonia Sasappo* Pallas belongs also to *Echinogorgia;* the 12th, *L. Boryana*, appears from the spicula to be a *Gorgonella*. Although it might be better, on some accounts, to dismember such a group and drop its name from the system, yet a close adherence to the laws of priority seems to require that the name should be so restricted as to include the first or typical species and congenic forms, and thus be retained in a modified sense. Adopting this view the genus, as modified, becomes equivalent to our *Litigorgia*.

As thus constituted it will include all *Gorgonidæ* having a horny axis; thin cœnenchyma, finely granulous at the surface and composed of very small warty spicula in the form of longer and shorter double-spindles, usually mingled with more or less numerous small heads and double heads; the polyp-spicula long and slender, simple, with few warts. The cells are usually arranged in lateral rows or bands, and may be either flat or more or less elevated on verrucæ.

The following species of which I have personally examined the spicula, and probably several others not yet seen by me, appear to belong to this genus.

A.—Dichotomously or arborescently branched; branches usually numerous, more or less elongated, often virgate, sometimes sub-pinnate.

a.—Cells not raised on prominent verrucæ, flat or slightly elevated.

L. viminalis E. and H. Mediterranean and Canary Isles.

L. rosea (Lam.) E. and H. Loc. (?). Perhaps a variety of the preceding.

L. Webbiana E. and H.* Canary Isles.

L. virgulata E. and H. (+*L. viminea*). North Florida to Cape Hatteras.

L. teres Verrill. "Bay of New York."

L. virgea E. and H. Antilles.

L. Floridana V., sp. nov. Florida.

L. Esperi V. (*G. violacea* Esper, *non* Pall.) V. West Indies (?).

L. festiva V. (Pterogorgia festiva Duch. and M.). Antilles. Perhaps the same as preceding.

* The spicula from the original specimens of this and the two preceding species are very much alike in size and form, and they may well prove to be mere variations of one species; similar variations in color, size and form of branches are constantly seen in *L. virgulata* from Charleston, S. C. The spicula of *L. Webbiana* and *L. rosea* agree most nearly, and both are a little stouter than those of *L. viminalis*.

L. clavata V. (Lophogorgia clavata Horn, Proc. Phil. Acad., 1860, p. 233). Locality unknown.

L. alba (Duch. and M.) Verrill. (Litigorgia lævis V., loc. cit.) Panama to San Salvador.

L. flexilis Verrill (Litigorgia V. op. cit.). Bay of Panama.

L. rigida Verrill, Bulletin M. C. Z., 1864. San Salvador to Cape St. Lucas and La Paz.

L. cuspidata Verrill, 1865. Zorritos, Peru, to Cape St. Lucas.

L. Caryi Verrill (Litigorgia fucosa V., Trans. Conn. Acad., i, p. 404, 1st ed., *non Gorgonia fucosa* Val.). Near San Francisco.

L. Peruana Verrill (Litigorgia, op. cit.). Callao.

L. Californica V. (Litigorgia, op. cit.). Lower California.

L. sarmentosa (Esper) Verrill. (? Gorgonella sarmentosa E. and H.). Mediterranean; Azores.

L. crista V. (Lophogorgia crista Mob.). Africa.

b.—Cells at the summit of distinct verrucæ.

L. pumicea Verrill (Gorgonia pumicea Val., E. and H.). Brazil; Rio Janeiro (U. S. Expl. Exp.).

L. miniata V. (Gorgonia miniata Val., E. and H.). Antilles.

L. ramulus V. (Gorgonia ramulus Val., E. and H.). Zorritos, Peru, to Acapulco.

L. pumila V. (Litigorgia pumila V., op. cit.). Zorritos.

L. diffusa V. (Litigorgia diffusa V., op. cit.). Panama Bay and Corinto, Nic.

L. hebes V. sp. nov. Key West, Florida.

L. radula V. (Gorgonia radula Mob.).

B.—Branches pinnate, bipinnate or tripinnate, spreading usually in a single plane.

a.—Cells scarcely raised on distinct verrucæ.

L. pinnata V. (G. pinnata Linn., ed. x). Gaboon, West Africa.

L. flammea (Ellis) V. (Lophogorgia palma E. and H., *non* G. palma Pallas). Cape of Good Hope.

b.—Cells on prominent verrucæ.

L. Floræ V. (Litigorgia Floræ V., op. cit.). Pearl Islands, Bay of Panama.

L. violacea (Pallas) V. (Pterogorgia petechizans E. and H. (?) *non* Pallas). West Coast of Africa at Sombrero I. (?).

L. sanguinolenta V. (Gorgonia sanguinolenta Pallas; V., Bull. M. C. Z., *non.* Esper; G. petechizans (pars) auct.). West Indies.

C.—Branches wholly or in greater part reticulated, flabelliform.

a.—Cells not raised on prominent verrucæ.

L. stenobrachis Verrill (Rhipidogorgia stenobrachis Val., E. and H.). Zorritos, Peru, to Gulf of California.

L. cribrum V. (Rhipidogorgia cribrum Val., E. and H.). New Zealand.

b.—Cells raised on distinct verrucæ.

L. Agassizii V. (Litigorgia Agassizii V., Tr. Conn. Acad. i, p. 388, 1st ed.). Acapulco to Cape St. Lucas.

L. Adamsii V. (Litigorgia Adamsii V., op. cit.). Zorritos, Peru, to Acapulco.

L. eximia V. (Litigorgia eximia V., op. cit.). Bay of Panama.
L. media V. (Litigorgia media V., op. cit.). San Salvador to Cape St. Lucas.
L. arenata V. (Rhipidogorgia arenata Val., Edw. and H.). New Zealand.

The following species, which Dr. Kölliker refers to his first section of the genus *Gorgonia*, probably belong to *Leptogorgia*, as modified, but I have not examined them.

G. umbella Esp. (Rhipidogorgia E. and H.).
G. venusta Dana (Rhipidogorgia E. and H.).
G. ventalina Linn. (Rhipidogorgia E. and H.).
G. cauliculus K. (Gorgonella Val., Leptogorgia E. and H.).
G. sanguinolenta Esp. (*non* Pallas); Köll., Icones, taf. xviii, fig. 239, (? G. petechizans Pallas).

Two species described by Duchassaing and Michelotti, *L. flavida* and *Gorgonia oblita*, are probably additional species.

Leptogorgia hebes Verrill, sp. nov.

Corallum branching in one plane, subdichotmous. The main trunk is rather stout, upright, giving off rather stout branches from each side subpinnately, at distances of ·25 to ·40 of an inch; the larger branches are somewhat rigid, tapering, dichotomously or subpinnately divided, mostly secund. The terminal branchlets are from one to four inches long, ascending, somewhat rigid. Cells small, arranged in lateral bands, apparently slightly raised, but the specimen is too much rubbed to show clearly the character of the surface. Axis black in the trunk and main branches, dark amber-color and translucent in the small branches, rigid and tapering to the tips. Cœnenchyma bright deep red. Height 6 inches; breadth 5; diameter of axis of trunk ·10; of larger branches ·06 of an inch. Spicula bright red, remarkably short and stout; the longer double-spindles are stout, oblong-oval, blunt, usually with two whorls of large warts on each half, the smaller whorl nearly terminal; stouter spicula scarcely shorter, much thicker, broad oval, each end usually having two close whorls and a terminal cluster of large rough warts. The longer double-spindles measure ·108^{mm} by ·048^{mm}, ·108 by ·036, ·092 by ·048, ·084 by ·040; the stouter ones ·108 by ·060, ·096 by ·060, ·090 by ·048.

Key West, Florida,—Maj. E. B. Hunt. This is very distinct from all other Atlantic species known to me, by the very stout, obtuse spicula.

Leptogorgia pumicea Verrill (*Gorgonia pumicea* Val., Edw. and Haime).

Corallum much branched, the branches slender, irregularly subpinnate; terminal branchlets very slender, ·5 to 1 inch long, scarcely tapering. Verrucæ prominent, rather large, rounded, perforated at summit by the small oval or oblong cell, arranged alternately in two rows on each side of the branches, giving them a somewhat quadrangular appearance. Color deep purplish red. Height 6 or 8 inches; diameter of branches ·06 to ·08; of branchlets ·05; of verrucæ ·03.

Spicula deep red; the longer double-spindles acute at the ends, with about three whorls of crowded warts on each half; stouter ones shorter and thicker, obtuse, usually with two crowded whorls and a terminal cluster of warts on each half. The longer double-spindles measure ·120^{mm} by ·048, ·120 by ·042, ·108 by ·036, ·096 by ·042, ·096 by ·030; the stouter ones ·084 by ·048, ·078 by ·042, ·072 by ·035.

Rio Janeiro,—U. S. Exploring Expedition.

Leptogorgia Floridana V., sp. nov., (L. purpurea Verrill, Bulletin M. C. Z., p. 31, 1864, *non* Pallas).

Corallum dichotomous, dividing chiefly near the base, the larger branches usually dividing only two or three times, at distances of one or two inches. Branchlets slender, virgate, 6 to 12 inches long, round, slightly tapering, ascending and subparallel, cells scattered over the whole surface, except on a narrow median space, rather large, oblong-oval, usually flat, but often raised on low verrucæ, especially on the large branches. Axis blackish in the main branches, horn-yellow, translucent, slender and flexible in the branchlets. Color generally brick-red, or dull dark red, sometimes purplish. Height 15 inches; breadth 5; diameter of larger branches ·10 to ·12 of an inch; of branchlets in middle ·08 to ·10; of their axis ·02 to ·03. Spicula deep red and yellowish red; longer double-spindles slender, acute, with three or four well separated whorls of small, not very close warts; stouter ones shorter, broader, and less acute, with fewer and more crowded whorls of warts; many small, slender spicula have but one or two distant whorls of warts on each half. The longer double-spindles measure ·132^{mm} by ·048, ·132 by ·036, ·120 by ·048, ·120 by ·042, ·120 by ·036, ·108 by ·048, ·096 by ·042; the stouter ones ·096 by ·048, ·090 by ·048, ·079 by ·042, ·079 by ·036; the small ones ·060 by ·030, ·054 by ·030, ·054 by ·024.

Florida Reefs.—G. Wurdemann.

This species externally somewhat resembles *L. virgulata* of the Carolina coasts, but has longer, more terete, and more regular branches. The spicula of the latter are very different, being much larger and longer (the double-spindles from ·144^{mm} by ·030, to ·192 by ·048), and relatively more slender, with five or six whorls of warts on each half. The authentic spicula of *L. virgea* differ widely from those of this species, being much more slender and more distantly warted.

Leptogorgia clavata Verrill (Lophogorgia clavata Horn).

This species is quite distinct from any other known to me. It is peculiar in having short, clavate branchlets. Its color is yellowish red, or light minium-red. The spicula are also quite characteristic. They are light red, mostly stout and rather blunt. The longer double-spindles are usually acute at the ends, with a wide median space, each end with two very unequal whorls of large, well separated warts; the stouter ones are more abundant, short and thick, with blunt or obtuse ends, each half having a whorl of large rough warts and a much smaller whorl at the end blend-

ing with the small terminal cluster; closely warted heads and double-heads also occur; the polyp-spicula are very long and mostly remarkably slender.

The longer double-spindles measure ·108^{mm} by ·036, ·092 by ·042, ·084 by ·036, ·079 by ·036; the stouter ones ·084 by ·048, ·079 by ·042, ·072 by ·042, ·072 by ·054; double-heads ·054 by ·042, ·042 by ·042, ·030 by ·030; polyp-spicula ·192 by ·036, ·168 by ·012, ·132 by ·024, ·132 by ·018, ·120 by ·012.

Locality unknown. (Coll. Phil. Academy.)

Eugorgia aurantiaca V. (E. Mexicana V., this Journal, xlv, p. 415, 1868; Trans. Conn. Acad., i, p. 410. = Lophogorgia aurantiaca Horn, 1860, = Gorgonia bicolor Val. MS., Paris Mus.).

The *Leptogorgia aurantiaca* of Edw. and Haime proves to be an *Echinogorgia*, therefore there is no longer any reason why the present species should not take the same specific name, which appears to be the earliest one published.

We have recently received numerous large and beautiful specimens from the Gulf of California, from J. Pedersen.

Gorgonia Linn. (sens. mod.). = Gorgonia (pars) and Pterogorgia (pars) Ehr.; Pterogorgia (pars) Dana; Leptogorgia (pars), Rhipidogorgia (pars), Pterogorgia (pars), Xiphigorgia, Phyllogorgia, and Hymenogorgia Edw. and Haime.

It has become necessary to restrict this genus to those species having small double-spindles, mingled with small bracket-shaped or crescent-shaped spicula, corresponding to Dr. Kölliker's second section of *Gorgonia*, as suggested by me in a former article (Trans. Conn. Acad., i, p. 386, 1868).

As thus limited the species known to me may be arranged thus:

A.—Flabelliform, branches reticulated and coalescent, with open meshes, (Rhipidogorgia).

G. flabellum Linn. Bermudas; Florida; West Indies.

G. occatoria (Val.) V. Guadaloupe.

B.—Plumose or panicled; the branches regularly pinnate, usually long and slender, with the cells in rows along the sides, (typical Pterogorgia).

G. acerosa Pallas. (*G. setosa* Linn., Ed. xii). Bermudas; Florida; West Indies.

G. turgida (Ehr.) V. Florida; Burmudas; West Indies.

G. Americana Gm. (P. Ellisiana E. and H.). Florida; West Indies.

G. Sloanei (?) (E. and H.) V. West Indies.

G. setosa (? Linn. pars, *non* Esper). West Indies.

C.—Flabelliform; the branches bipinnate, sparingly coalescent, flattened.

G. bipinnata V. (Pterogorgia bipinnata V., Bulletin M. C. Z., p. 37, 1864). Cumana, Ven.

D.—Dichotomous, with elongated, slender branches.

G. miniacea Esper. (Leptogorgia miniacea E. and H.

G. tenella V. (= Gorgonia ceratophyta Esper, tab. xix, *non* Linn. *nec* Pallas). Perhaps young.

G. gracilis V. (Pterogorgia, Trans. Conn. Acad., vol. i, p. 359 1868). Abrolhos Reefs, Brazil.

G. sanguinea Lam. (Leptogorgia sanguinea (pars) E. and H.). Locality unknown.

E.—Dichotomous, often fasciculate; the branches ascending; with the cœnenchyma developed laterally into marginal wings, thus producing flat or triquetral branches, with the cells in rows along the edges, (Xiphigorgia).

G. anceps Pallas. Florida; West Indies.

G. Guadalupensis (Duch. and Mich.) V. Guadaloupe.

G. citrina Esper. Florida; Bahamas; St. Thomas.

G. pumila V. (=X. Americana D. and M., Supl., p. 113, Tab., 2, fig. 6, *non* G. Americana Gmel.). Perhaps a variety of the preceding. Antilles.

F.—Foliaceous, the branches slender, not reticulated, but the cœnenchyma laterally developed into broad, frond-like forms, (Hymenogorgia).

G. quercifolia Ehr. West Indies; Guadaloupe, etc.

G.—Flabelliform and foliaceous, the branches reticulated and coalescent, but the meshes closed by the lateral development of the cœnenchyma, (Phyllogorgia).

G. dilatata Esper. Bahia, Brazil.

G. foliata (Val.) V. Guadaloupe.

Several other described species of Gorgonidæ, which I have not seen, appear to belong to this genus, judging from external characters.

Eunicella Verrill, gen. nov.

Gorgonia (pars) Pallas and subsequent authors, (*non* Linn. Syst. Nat., ed. x); Eunicea (pars) Ehrenberg; Gorgonia (pars) Dana; Gorgonia (pars) Edw. and Haime; Kölliker.

Cœnenchyma thin or moderately thick, composed chiefly of small warty double-spindles, but having a distinct external layer of very small, peculiar, club-shaped spicula perpendicular to the surface, which often have one or two whorls of fine spinules toward the larger end. Cells scattered, either raised on prominent verrucæ or perfectly flat. Longitudinal ducts nearly equal, in a circle around the axis. Color, usually white. (Type *Gorgonia verrucosa* Pallas).

In the work of Edwards and Haime the name, *Gorgonia*, is applied to a group of 14 nominal species, of which 5 belong to this genus. Their 1st species is *Muricea vatricosa* Köll.; the 2nd appears to include a *Muricea* and an *Echinogorgia;* the 6th is *Thesea* or *Swiftia exserta;* the 7th, 8th and 9th are *Leptogorgiæ;* while the 10th and 11th also, do not belong to this genus. One of the principal characters of their genus (prominent cells) excludes several true species of *Eunicella.* Moreover the genus appears to belong properly in the *Plexauridæ*, and to be closely allied to *Eunicea* and *Plexaura* in structure. The forms of the spicula are the principal characters for distinguishing it from *Eunicea*, for certain species (*E. palma*, *E. papillosa*) often have a thicker cœnenchyma than some species of *Eunicea.* It must, consequently, be excluded from the family, *Gorgonidæ*, as now restricted.

Ehrenberg united this group with *Eunicea*, and restricted *Gorgonia* to a group having *G. flabellum* as its type.

Finally, no species of this genus was known to Linné when he first established the genus, *Gorgonia* (Syst. Nat., ed. x), in which

he included *G. flabellum* and other well known species of the same group.

For these reasons I have been led to apply a new and distinctive name to this well-marked genus, and to restrict *Gorgonia* to those species allied to *G. flabellum*, in accordance with a suggestion made by me in a former work,* which, indeed, seems to be the only alternative, if we adopt the generally accepted laws of priority.

As thus defined this genus corresponds with Dr. Kölliker's third section of *Gorgonia.*

The species which I have personally examined are as follows:

A.—More or less flabelliform, much branched; cells prominent.

Eunicella verrucosa (Pallas) V. Mediterranean.
E. venosa (Val.; E. and H.) V. Algeria; Madeira.
E. subtilis (Val.; E. and H.) V. Algeria.
E. tenuis V. (sp. nov.). West Indies. (?)

B.—Branches dichotomous, elongated, slender; cells prominent or flat.

E. graminea (Lam.) V. Mediterranean; Naples.
E. Bertolonii (Lamx.) V. Mediterranean.
E. crinita (Val.) V. Archipelago Bizagos, Africa.

C.—Low, fruticose, branches short and stout; cells prominent.

E. papillosa (Esper) V. Cape of Good Hope.

D.—Palmate, branches flattened, elongated; cells scarcely prominent.

E. palma V.† (G. palma Pallas; G. albicans Köll.). Cape of Good Hope.

Eunicella tenuis, sp. nov.

Somewhat flabelliform, a foot or more high, densely branched, the ultimate branches subpinnate, giving rise to short alternating branchlets, about ·25 of an inch apart. These are about ·3 to ·6 of an inch long, and ·05 in diameter, exclusive of the verrucæ, with the tips dilated and bilobed. The verrucæ are small, but prominent, conical, on the branchlets unequal, alternating on the opposite sides, about their own diameters apart; height of the largest about ·05, diameter ·03 or ·04. Color white. The larger double-spindles are slender, acute, with a wide median space, each half covered with rather distant, small, conical warts, those nearer the center larger and in whorls, the rest scattered, decreasing in size to the ends; clubs very small, short, rather broad, the large end flattened, often winged or triquetral, triuncate or slightly rounded, usually with two or three slight teeth or serrations on each edge, but these are often wanting, the small end surrounded by a close whorl of very small, rough warts, and terminated by one to three small points or papillæ. The longer double spindles measure ·196^{mm} by ·048, ·196 by ·036, ·184 by ·048, ·184 by ·036, ·172 by ·048, ·172 by ·036; the clubs ·072 by ·036, ·072 by ·030, ·066 by ·036, ·060 by ·042, ·060 by ·036.

West Indies (?). (Mus. Yale College and Phil. Acad.).

The spicula of this species do not approach very nearly those of

* Trans. Conn. Acad., i, p. 386, April, 1868.

† Pallas' description applies to this species, and not to *Leptogorgia flammea.*

any other, except *E. subtilis*, which, however, has considerably smaller and more warty spindles.

If the locality be correct, it is remarkable as the only American species of a genus very common on the opposite coasts of the Atlantic.

Psammogorgia fucosa V. (Gorgonia fucosa Val., Voy. de la Venus, Pl. 15 bis, 1846; Plexaura fucosa, Edw. and Haime, Corall., p. 154, *non* Verrill). The spicula from the original example of this species show that it is very distinct from the species that I have hitherto referred to it (*Leptogorgia Caryi*). It appears, judging from the spicula, to be a *Psammogorgia*, allied to *P. teres*, but quite distinct. The figure represents it as 10 inches high and 9 broad, with the branches about ·15 of an inch thick, enlarged at the axils. Several stems arise from one base, as is usual in *P. arbuscula*, the largest trunk being half an inch in diameter. The branches are irregularly dichotomous, the divisions being ·5 to 2 inches apart; the final branchlets are stout, scarcely tapering, obtuse or clavate at the ends, often crooked, ·5 to 1 inch long, ·12 to ·18 of an inch in diameter. Cells small, oblong or oval, flat on the branches, slightly raised on the branchlets. Color, dull reddish.

It is remarkable for the great diversity in form and color of the spicula. These are white, yellowish, light red, deep red, and amethystine intermingled. They are mostly stout, blunt, and covered with large rough warts. Among them are various forms of spindles, double-spindles, double-heads, heads, and stout warty clubs, with various irregular forms. The stout double-spindles, which are most numerous, are short and thick, mostly with obtusely rounded ends, sometimes acute, median naked space narrow, bordered by whorls of large, coarse, rough warts, beyond which there are usually one or two whorls of smaller warts and a terminal cluster, but in many cases there are none between the median whorls and the terminal cluster, in other cases the whorls become crowded and thus the forms pass into large, stout "double-heads," in which the ends are rounded and densely covered with rough warts.

Numerous spicula lack the naked median space and are densely covered with large rough warts, some of these are short and rounded, in the form of heads; others are longer, tapering at both ends, and have the form of very stout spindles; others are large at one end, with the other tapering, or club-shaped. The polyp spicula are long, slender spindles, tapering quite regularly to both ends and covered with small warts. The large double-spindles measure ·156^{mm} by ·072, ·156 by ·066, ·150 by ·072, ·144 by ·084, ·144 by ·060; the smaller ones ·120 by ·060, ·108 by ·060, ·072 by ·048; double-heads ·132 by ·096, ·132 by ·090, ·096 by ·084; the heads ·108 by ·084, ·048 by ·048; the stout spindles ·156 by ·072, ·144 by ·072, ·120 by ·072; the clubs ·144 by ·084, ·144 by ·072, ·096 by ·048; the polyp-spicula ·156 by ·030, ·156 by ·024, ·144 by ·024, ·102 by ·024.

Mazatlan,—Voyage of the Venus.

Echinogorgia aurantiaca Verrill (=Plexaura aurantiaca Val.; Leptogorgia aurantiaca E. and H., Corall. i, p. 165).

The spicula of this species show that it is an *Echinogorgia*, pretty nearly allied to *E. sasappo*. The spicula are yellow, mostly large, broad, flattened clubs, or scale-clubs, the smaller end often acute, sometimes blunt, covered with rough warts, the large end usually terminating in one or more broad, flat, irregular, rounded scales, which are often lobed, or even subdivided into sharp, lacerate spinules. With these are many more or less regular four-branched crosses, with rather slender, acute, warty branches; and various forms of irregular, often branched, warty spindles, and compound spicula.

The clubs and scale-clubs resemble those of *E. sasappo* figured by Dr. Kölliker in his Icones Histiologicæ, Taf. xviii, figs. $9_{,1}$ and $9_{,3}$. The scale-clubs measure ·290^{mm} by ·216^{mm}, ·288 by ·204, ·288 by ·156, ·264 by ·192, ·260 by ·168, ·240 by ·156, ·216 by ·156, ·192 by ·132, ·192 by ·084, ·180 by ·084; the crosses ·240 by ·192, ·180 by ·156, ·144 by ·120, ·120 by ·096; the irregular spindles ·336 by ·072, ·288 by ·084, ·252 by ·084.

Callao, Peru. Mus. Paris.

Thesea gemmata, sp. nov.

Corallum flabelliform, much branched; branches long, slender, seldom coalescent. The trunk is roundish, moderately stout, upright, giving off from each side at distances of ·5 to ·75 of an inch numerous very long, flexible, spreading branches, which in turn give rise to numerous secondary branches and branchlets arranged subpinnately, at distances of about half an inch. The terminal branchlets are from two to five inches long, very slender, flexible, covered with a thin cœnenchyma, and bearing large, prominent verrucæ, arranged alternately on opposite sides, at distances of about ·20 to ·25 of an inch; two verrucæ are usually terminal, producing a broad flattened tip, as in many other Gorgonians. The verrucæ are swollen at the base, the edge divided into eight triangular lobes at summit, surmounted by a subconical mass of spicula belonging to the basal portion of the contracted tentacles, which seem to have been incapable of retraction within the cells. Cœnenchyma thin and friable, and like the verrucæ composed mostly of rather slender spindle-shaped spicula, with a superficial layer of very small spicula, giving the surface a granulous appearance under a lens. Axis nearly smooth, with numerous very fine striations, black in the trunk and larger branches, brownish and setiform in the branchlets. Cœnenchyma and verrucæ white.

Height 17 inches; breadth 12; diameter of trunk ·18; of larger branches ·10 to ·12; of branchlets ·03 to ·04; of verrucæ at base ·07 to ·08; at summit ·05 of an inch. The cœnenchyma is chiefly composed of long, slender, rather acute spindles, with small, distant, conical spinules; the superficial layer is composed of small, short, warty double-spindles, double-heads, heads, and oblong spicula with two whorls of conical warts toward the center. The

double-spindles are obtuse and usually bear one whorl and a large terminal cluster of rough warts on each end. The spicula of the tentacles are long, mostly curved or crooked, distantly warted spindles, which are generally shorter and thicker than those of the cœnenchyma, and bear smaller and more distant spindles.

The larger spindles of the cœnenchyma measure ·984^{mm} by ·096^{mm}, ·840 by ·096, ·720 by ·108, ·720 by ·060, ·696 by ·096, ·696 by ·060, ·684 by ·108, ·672 by ·072, ·648 by ·066, ·600 by ·072; the small double-heads and double-spindles of the surface ·108 by ·048, ·090 by ·048, ·084 by ·048, ·072 by ·042; the small oblong spicula ·108 by ·048, ·096 by ·048, ·092 by ·042, ·090 by ·036; the heads ·098 by ·060. The larger spinules from the tentacles ·840 by ·096, ·720 by ·084, ·660 by ·108, ·624 by ·108, ·824 by ·096, ·540 by ·108, ·540 by ·048, ·516 by ·096, ·408 by ·096.

St. Croix, West Indies,—J. Alexander Moore. The specimen was obtained in deep water by a fisherman. Attached to it was a fine *Astrophyton cœcilia* Lutk.

This species resembles in external characters *Gorgonia exserta*, as figured by Ellis and Solander, which Duch. and Michelotti refer to their *Swiftia exserta*, but it has more prominent verrucæ. Its spicula are very different from those of *Thesea Guadalupensis* D. and M., and *Swiftia exserta*. The "*Gorgonia Richardii*" D. and M., Corall. Antilles, Tab. iv, fig. 1 (*non* Lamouroux), bears some resemblance to it in external appearance, but has stouter branches and more cylindrical verrucæ. The latter may, quite probably, be an allied species of *Thesea*.

2. *Note on Hyponome Sarsii, a recent Cystidean; by S. Lovén.** —The general appearance of this very remarkable Echinoderm is that of a small starfish or a Euryalid. It has a disk, convex on the ventral surface, flattened on the dorsal, and five short and broad rays; each of these is divided into two short dichotomous branches, terminating in four very short rounded lobes. As in the recent genera, *Antedon* and *Pentacrinus*, a large, conical, proboscis-like funnel rises in one of the interradial spaces of the ventral surface of the disk; and from a point situated a little before the center of the same surface five narrow channels, protected by marginal scales, radiate and, bifurcating thrice, run out on the rays and their branches, giving off short branchlets to certain sacculate protuberances placed at regular distances. No pinnulæ. On the protuberances and on the rays the channels are open; but upon the disk, between their first bifurcation and their common starting-point, their marginal scales close over them, forming a vault, so that the five channels are converted into covered ducts, converging into a common subcentral aperture, concealed beneath the integument, and not visible from the outside. In the covered parts of the channels I found masses, consisting of microscopic Crustacea, larval bivalves, and other remains of the food of the

* We are indebted to the Author for the communication of this translation from "Forhandlinger ved de Skandinaviske Naturforskeres tiende Möde, i Christiania," July, 1868.

animal, apparently taken through the ends and open parts of the channels, and on its way, through their covered parts, to the concealed mouth. On the rays, near their tips, are seen some few pores, perhaps indicating the existence of retractile organs. The ventral surface is clothed with rather small, thick-set, irregular whitish scales, among which, in certain places, some six or seven larger ones are seen forming a rosette. Between the rays and their bifurcations this scaly covering of the ventral surface extends back on to the dorsal surface, ending there with great regularity in triangular spaces pointing to the center of the disk. The remainder of the dorsal surface of the disk and the rays, which, by this arrangement, assumes the form of a regular star with five broad dichotomous rays, is clothed with a soft and smooth brownish skin. There is no trace of a calyx. In the center of the even dorsal face of the disk is seen a somewhat pentagonal space studded with minute pores.

To have the channels on the disk converted into tunnel-like passages leading to a mouth concealed beneath the integument is a peculiarity hitherto not observed in any recent Crinoid; but it is, as shown by Professor Huxley and Mr. Billings, a characteristic of the palæozoic Crinoids and Cystideans. The absence of any indication of a calyx at once excludes *Hyponome* from the former. Among the Cystideans it recalls the genus *Agelacrinites*, of Vanuxem, by the depressed form of the body, the scaly covering, and the flatness of the dorsal surface, devoid of anything like a stem or peduncle, and also by the absence of pectinated rhombs and of pinnulæ. Branchlets running from the channels to sacculate protuberances are found also in the genus *Glyptocystites* of Billings and *Glyptosphærites* of Johannes Müller; and bifurcations of the channels are met with in *Sphærocystites* and *Callocystites* of Hall. Lastly, the genus *Hyponome* shares with the surviving type of the Crinoidea the radiated form of the body and the simply conical unprotected funnel.

The specimen described is from Cape York, Torres Strait.—*Annals and Magazine of Nat. Hist.*, Sept., 1869.

3. *New Localities of Artemia;* by A. E. VERRILL.—At the late meeting of the American Association at Salem, Prof. Agassiz stated that he had observed an *Artemia* (probably *A. gracilis* V.) several years ago in the salines on Cape Cod. During the meeting Dr. G. H. Perkins found a fine colony of *A. gracilis* in a tub of sea-water on the bridge of the Eastern R. R. across Charles River at Charlestown, near Boston. I have recently received specimens with Dipterous larvæ from Great Salt Lake, through S. A. Briggs, Esq., and others from Prof. D. C. Eaton collected by Mr. Sereno Watson. They belong to a new species, more nearly allied to *A. gracilis* than to *A. Monica*. The males have larger and more acute claspers than even in *A. gracilis;* the second joint is broader and very strongly angled outwardly, and between the angle and the point the outline is decidedly concave. I propose to call it *Artemia fertilis*.

4. *Additamenta ad historiam Ophiuridarum*, Part III; by CHR. FR. LUTKEN, (Vidensk. Selsk. Skr., 5 Række, naturvid. og mathematisk Afd. 8 B. II, 4to, 109 pp. Copenhagen, 1869).—This important work contains ten critical and descriptive essays on various genera and species of Ophiurians, including many new forms. These are followed by a synopsis of all the genera of true Ophiurians, with Latin and Danish descriptions of each, and a tabular view of the classification adopted; by Latin diagnoses of the new genera and species; and by a résumé, in French, of the whole work. The tenth essay contains a critical review of the various genera of fossil Ophiurians hitherto described.

The new genera are as follows: OPHIONEPHTHYS (type, *O. limicola* nov., St. Thomas); OPHIONEMA (type, *O. intricata* nov., St. Thomas); OPHIOCONIS (type, *Pectinura Forbesii* Heller); OPHIOPSAMMUS (type, *Ophiopeza Yoldii* Lutk.); OPHIOCHÆTA (type, *O. setosa* nov., Feejees); ASTEROMORPHA (type, *A. Steenstrupii* nov., loc. unknown), a very interesting new genus, allied to *Astrophyton*, etc., with undivided arms; OPHIARACHNA is restricted to *O. incrassata* and similar species, while the other species are separated as a very distinct genus, to which the name, PECTINURA Forbes (*non* Heller), is restricted.* The following new species are also described: *Amphipholis fissa*, Amour; *Ophiarachna affinis*, Feejee Is.; *Ophiomastix mixta*, Samoa and Feejee Is.; *O. asperula*, Feejees; *O. caryophyllata*, Feejees; *Ophiomyxa australis*, Straits of Bassiano; *Ophiocoma canaliculata*, with the last; *Ophiacantha Pentacrinus*, Antilles, adhering to *Pentacrinus*; *Ophiothrix elegans*, China Sea; *O. trilineata*, Samoa Is.; *O. Capensis*, Cape, on Gorgoniæ. *Ophiactis clavigera* Ljung. is referred to *Ophiacantha* and identified with *Asterias tricolor* Abjd. (Zoolog. Danica, t. 97), and it is suggested that "*Ophiocoma granulata*," found by Wallich at the depth of 1,260 fathoms, may be the same species. The West Indian species, hitherto referred to *Ophiothrix violacea*, is separated as a new species, *O. Caribæa* Lutk. Two species of this genus, *O. echinata* M. & Tr. and *O. quinquemaculata* (d. Ch.) are described from the Mediterranean. *Astrophyton Agassizii* Stimp. is reported from Greenland and Finmark, though not before known north of the Gulf of St. Lawrence. The classification adopted is based chiefly upon the structure of the parts of the mouth. A. E. V.

5. *Synopsis of the Polyps and Corals of the North Pacific Exploring Expedition, under Commodore C. Ringgold and Capt. John Rodgers, U. S. N., from* 1853 *to* 1856. *Collected by Dr. Wm. Stimpson, Naturalist to the Expedition*; by A. E. VERRILL. Part IV, Actinaria, with three plates. (From the Proceedings of the Essex Institute, vols. v and vi, 8vo. Salem, Mass., March to October, 1869.)—This final part includes descriptions of the Actinians obtained by the expedition, and also a supplement con-

* The species recently described by me under the name, *O. maculata*, (Proc. Bost. Soc. Nat. Hist., xii, p. 388) belongs to the latter group, and should be called *Pectinura maculata*.

taining corrections and additions to the previous parts, together with geographical lists of all the species. The following new genera and species are described: *Halocampa Stimpsonii*, Cape of Good Hope; *Actinia? timida*, Hong Kong; PARANTHEA (type *P. minuta*, Bonin Is.); *P. armata*, Hong Kong; *Phellia inequalis*, Bonin Is.; *Phellia arctica*, Arctic Ocean; *Cereus Stimpsonii*, Cape of Good Hope; *Cereus Sinensis*, Hong Kong; *Sagartia? Paguri*, China Sea; *Sagartia lineata*. Hong Kong; *Bunodes Japonica*, Island of Jesso; PHYSACTIS (type, *P. multicolor* Stimp. sp., Hong Kong); *Anthopleura Stimpsonii*, Hong Kong; AMPHIACTIS (type, *A. orientalis* nov., Bonin Is.); *Discostoma fungiforme*, Bonin Is.; HOMACTIS (type, *H. rupicola* nov., Hong Kong); STEPHANACTIS (type, *S. Indica* nov., Gaspar Straits).—In the Supplement: EUPLEXAURA (type, *E. Capensis* nov., Cape of Good Hope); *Madrepora microphthalma*, Loo Choo Is.; *Montipora lichenoides*, Loo Choo Is.; *M. exesa*, Gaspar Straits; *M. patula*, Hawaiian Is.; *Turbinaria dichotoma*, unknown; *Pocillipora gracilis*, Loo Choo Is.; *P. Danæ*, Feejees; *P. aspera; P. nobilis;* and *P. frondosa*, Hawaiian Islands. In addition to these many other species previously known only by imperfect or very brief descriptions are described at length, and many changes have been made in their nomenclature.

6. *Review of the Corals and Polyps of the West Coast of America;* by A. E. VERRILL. (From the Transactions of the Connecticut Academy, Vol. I, New Haven; February and March, 1869).—The signatures containing the Order, Actinaria, were published and partially distributed during February and March, 1869. Owing to the late fire by which the entire edition of the incomplete volumes of the Transactions was destroyed, with the exception of author's copies previously distributed, the publication of the balance of this memoir will be considerably delayed. On the west coast the three suborders of ACTINARIA (*Actinacea, Zoanthacea* and *Antipathacea*) are represented. In the sub-family, Phyllactinæ, we have described *Oulactis concinnata; Lophacti ornata* (gen. et sp. nov.); *Asteractis Bradleyi* (gen. et sp. nov.). Of the family Actinidæ, we find in the sub-family, Bunodinæ, *Bunodes cruentata* Gosse; *P. papillosa* V. (Lesson); *B. pluvia* V. (Drayton); *B. ocellata* V. (Lesson); *Urticina crassicornis* Ehr.; *Evactis artemisia* V. (gen. nov., type, *Actinia artemisia* Drayton); *E.* (?) *xanthogrammica; Cladactis grandis* V. (gen. et sp. nov.); *Cystiactis Eydouxi; Anthopleura Dowii* nov.; *Phymactis clematis; P. florida*:—in the sub-family, Sagartinæ, are *Metridium fimbriatum* V.; *M. reticulatum; Actinia* (?) *Mertensii* Brandt; *Cereus Fuegiensis* V. (Couthouy); *Calliactis variegata* (gen. et sp. nov., type of genus, *C. decorata* Drayton sp.); *Sagartia impatiens* Gosse; *S. lineolata* V. (Drayton); *S. crispata* nov.; *S. carcinophila* nov.; *S. Panamensis* nov.; *S. Bradleyi* nov.; *S. nivea* V. (=*Actinia nivea* Lesson, *non S. nivea* Gosse=*S. Gossei* V.) *S. Lessonii* V. (=*Actinia bicolor* Lesson, *non* Lesueur); *S.* (?) *Peruviana* V. (Lesson); *S.* (?) *nymphæa* V. (Drayton);

S. (?) *rubus* V. (Drayton); *Nemactis primula* E. and H.; *N. Draytonii* E. and H.; *N.* (?) *Chilensis* V. (Lesson);—in the sub-family, Phellinæ, *Phellia inornata* nov.; *P.* (?) *rubens* nov.; *P. Panamensis* nov.; *P. arctica* V.;—in the sub-family, Actininæ, *Paractis* (?) *nobilis* nov.; *Epiactis prolifera* V. (gen. et sp. nov.) Puget Sound; *Anactis picta* Ehr. (Lesson). The suborder, ZOANTHACEA, is represented by *Mammillifera Danæ* V. (LeConte); *M. nitida* nov.; *M. conferta* nov.; *Gemmaria elongata* nov.; *G. humilis* nov.; *G. crassa* nov., (the name, *Gemmaria* having been first employed for a genus of Acalephs by McCready, *Epizoanthus* Gray (emended) should be substituted for it). The ANTIPATHACEA are represented as yet only by *Antipathes Panamensis* nov. *Montipora fragosa* (sp. nov.) from "California" is also described.

All the new species of Actinians, except *Epiactis prolifera*, are from the Panamian Fauna. *Epiactis* is a very interesting form, remarkable for producing numerous lateral buds in a circle around the column, which appear to become free when still quite small, though furnished with mouth, disk, and tentacles. V.

7. *The Butterflies of North America.* Part IV; by WM. H. EDWARDS, (American Entomological Society, Philadelphia, April, 1869).—This beautiful number contains five plates, with twenty-nine figures, profusely illustrating the following species: *Argynnis Leto* Behr., *Colias Eurytheme* Boisd., *C. Keewaydin* Edw. sp. nov., *Thecla Ontario* Edw., *T. strigosa* Harris, *Limenitis Weidemeyerii* Edw. The synopsis of N. American Butterflies contains the remaining species of *Pieris*, *Neophasia*, *Nathalis*, *Anthocaris*, and *Callidryas*. The execution of the plates is admirable. V.

8. *On Remains of the Beaver in New Jersey;* by MASON C. WELD. (In a letter to one of the Editors).—I take the occasion of the recent discovery of a very interesting and novel fact to me to communicate with you. It is the finding of a genuine Beaver meadow, on the very top and near the brink of the Palisades. The edge of the meadow is about 175 paces from the "steep rocks," which are, I suppose, about 500 feet above tide water in the Hudson river, and which rises so abruptly, that a stone may in some places be thrown from the top into the water.

Stumps gnawed off by beavers were found by workmen, getting out swamp-muck on the land of Mr. Charles Nordhoff, and in the rear of his residence. The trench in which they were found (6 or 7 feet below the surface) is about 10 feet deep, and though it was in the midst of the severest drought we had had for many years, water soon flowed into it. An eight foot well on the place has contained a constant supply of water. An excavation made for a fish-pond, within ten rods of the steep rocks, filled up with water to the depth of two or three feet, without receiving a gill from rains or from the surface. Wells, springs and brooks along the western slope and in the valley have gone dry in great numbers, while here and elsewhere along the top of the Palisades, there has been an abundant supply. The beavers must have had permanent water. The size of the meadow is not more than four

or five acres; the depth of the peat variable and uncertain; the bottom of the basin where exposed consists of a fine sandy hard-pan with some small boulders and masses of trap, and the trap-rock in place is occasionally denuded.

To appearance there is an abundance of water along this whole range, which cannot be accounted for by the rainfall, and yet it is isolated by miles of intervening hills and valleys from equally high land. Permanent springs little influenced by the season, or by abundance or dearth of rain are not rare on the western slope of the Palisades, and they are found on some of the highest points; one quite noted one is near Crumm's Rock, the highest point.

Closter, New Jersey, Sept. 19, 1869.

IV. ASTRONOMY.

1. *Observations on the Eclipse of August*, 1869; by Prof. J. WINLOCK. (Communicated through Dr. Wolcott Gibbs, for this Journal).—In the observations of the solar eclipse of August 7th, made at Shelbyville, Kentucky, a spectroscope of two flint glass prisms by Troughton & Simms similar to the one described by Mr. Huggins, (Phil. Trans., 1864, part II,) was used. It was attached to an excellent equatorial telescope by Merz of 7½ inches aperture and 9½ feet focal length. The chromosphere was carefully examined both before and after the eclipse; only three lines could be seen: C, one near D, and F. During totality only the brightest protuberance on the lower limb of the sun was examined carefully. In the short time occupied in getting into this, nothing was seen but a faint continuous spectrum; but since the observing telescope took in only a small part of the spectrum at once, nothing conclusive can be inferred from the observation as to the non-existence of bright lines in the corona.

During totality eleven bright lines were seen. Besides the three described above, there was a short line at or very near E, the three lines of *b* were bright and very sharp, and there were four lines above F. Although these lines were very bright on a dark ground, all of them but the three seen before the eclipse disappeared instantly on the first burst of sunlight, and the same point in the sun's disk was examined with great care after totality without finding any of the lines but those above described.

The photograph of the corona taken at Shelbyville shows a flattening at the extremities of the sun's axis, and an elevation about the equatorial region. The appearance can be explained by the hypothesis that it is a photographic view of the sun's atmosphere, and the form is that which it would assume from the sun's rotation about its axis, with its upper surface disturbed by the protuberances or flames below, and by large waves which are to be expected in such an atmosphere.

2. *Relations to the Corona of the aureole visible in the photographs of the total eclipse.*—Dr. B. A. GOULD in a letter to Prof. Morton, published in the Journal of the Franklin Institute for Oct.

(p. 222), says: "An examination of the beautiful photographs made at Burlington and Ottumwa, by the sections of your party in charge of Professors Mayer and Himes, and a comparison of them with my sketches of the corona, have led me to the conviction that the radiance around the moon, in the pictures made during totality, is not the corona at all, but is actually the image of what Lockyer has called the chromosphere.

"This interesting fact is indicated by many different considerations. The directions of maximum radiance do not coincide with those of the great beams of the corona; they remained constant while the latter were variable; there is a diameter, approximately corresponding to the solar axis, near the extremities of which the radiance upon the photographs is a minimum, whereas the coronal beams in these directions were especially marked during a great part of the total obscuration. The corona beams stood in no apparent relation to the protuberances, whereas the aureole, seen upon the photographs, is most marked in their immediate vicinity. Indeed, the great protuberance, at 230° to 245°, seems to have formed a southern limit to the radiance on the western side, while a sharp northern limit is seen on all the photographs at about 350°, the intermediate arc being thickly studded with protuberances, which the moon displayed at the close of totality. The exquisite masses of flocculent light on the following limb are upon the two sides of that curious prominence at 93°, which at first resembled an ear of corn, as you have said, but which in the later pictures, after it had been more occulted, and its southern branch thus rendered more conspicuous, was like a pair of antelope horns, to which some observers compared it. Whatever of this aureole is shown upon the photographs, was occulted or displayed by the lunar motion, precisely as the protuberances were. The variations in the form of the corona on the other hand, did not seem to be dependent in any degree upon the moon's motion.

"The singular and elegant structural indications, in the special aggregations of light on the eastern side, may be of high value in guiding to a farther knowledge of the chromosphere. They are manifest in all the photographs by your parties which I have seen, but are especially marked in those of shortest exposure, such as the first one at Ottumwa. In some of the later views they may be detected on the other side of the sun, though less distinct. But the very irregular and jagged outline of the chromosphere, as described by Janssen and Lockyer, is exhibited in perfection."

3. *Observations of Prof. Pickering's party upon the Eclipse.*—Prof. E. C. Pickering who observed at Mount Pleasant, Iowa, concludes his report upon the eclipse as follows (Jour. Frank. Inst., Oct., p. 286): "In conclusion, the new facts elicited may be summed up as follows:—An increase of heat and actinic power is observed in the beginning of the eclipse, caused by an increased brightness of the sun's disc near the moon's limb. The spectrum of the corona appears to be free from dark lines, but may contain

two or three bright ones. Its striæ are spiral rather than radial, and its light is unpolarized. The sky adjoining it, however, reflecting light from the earth, shows strong signs of polarization."

4. *Meteors during the Eclipse.*—Prof. C. F. HIMES in his report speaks thus of certain phenomena (Jour. Frank. Inst., p. 278): "During the progress of the eclipse, Mr. Zentmayer, who examined the ground glass of the camera from time to time to notice the position of the image of the sun, called my attention to an appearance of small luminous bodies like meteors crossing the dark image of the moon from cusp to cusp. Subsequently, they were seen to pass over the ground glass from outside of the field on to the image of the sun, where of course they were lost, always coming from the same side. We were led by this circumstance to regard them as most likely to be optical illusions, perhaps insects with transparent wings or bodies, but the fact that other observers report a shower of meteors between the moon and the earth, which seemed to be, as far as I can gather from a hasty description, identical in appearance with the objects noticed by us, our observation may be of considerable value, especially as Mr. Zentmayer, who saw most of them, is disposed not to regard them as optical illusions, since they must have been caused by objects not less than 2,000 feet distant."

5. *Prof. Mayer's report of the Eclipse.*—Prof. A. M. MAYER and five assistants were stationed by Dr. Morton at Burlington. His full report of instruments, of methods, of work done and of results, is given in the Journal of the Franklin Institute for October. They took 41 photographs, five of them during the totality. From these photographs numerous measurements of the prominences and of the various phenomena of the eclipse have been made for comparison with results from other observers and photographs. In his closing section, he points out "the peculiar value of photography in the observations of the transits of Venus."

6. *Radiation of heat from the Moon.*—The present Earl of Rosse is worthily employing the telescope constructed and so well used by his father. He has recently made a series of experiments upon Lunar radiant heat (Proc. Roy. Soc., 112) with a view of determining in what proportion the moon's heat consists of (1) that coming from the interior of the moon which will not vary with the phase; (2) that which falls from the sun on the moon's surface, and is at once reflected regularly and irregularly; and (3) that which falling from the sun on the moon's surface, is absorbed, raises the temperature of the moon's surface, and is afterward radiated as heat of low refrangibility.

His results suggest to him that the law of variation of the moon's heat will probably be found not to differ much from that of the moon's light. It therefore follows that not more than a small portion of the moon's heat can come from the first of the three sources named.

Also, the greater part of the moon's heat which reaches the earth appears to have been first absorbed by the lunar surface.

From a single series of eighteen readings of the galvanometer for the sun's heat he obtained the ratio of lunar to solar radiation of 1 : 89819.

The amount of lunar heat appears to indicate an elevation of temperature for the moon's surface at full moon of 500° Fahrenheit.

V. MISCELLANEOUS SCIENTIFIC INTELLIGENCE.

1. *Collections of the Maine Historical Society*, Vol. I.—Having given up so much space in this number of the Journal to the Geographical and Historical Notes of Mr. Stevens, we desire to call the particular attention of our readers to a recent publication which has been in some degree the occasion of this essay, and which is a most comprehensive and convenient summary of the views which have heretofore been commonly received respecting the early discoveries of this continent.

Rev. Leonard Woods, D.D., lately President of Bowdoin College, was commissioned by the Maine Historical Society a short time since, to investigate in Europe the early History of Maine, for the purpose of securing as much as possible of the documentary records. In the course of his inquires, which were fruitful in many ways, he came upon the well known traveler Dr. J. G. Kohl of Bremen, who has spent many years in the study of the Atlantic sea-board, and who was at one time expectant that his researches would be published under the auspices of one of the national establishments at Washington. Dr. Kohl was readily enlisted by Dr. Woods in the preparation of a Memoir on the coast of Maine, regarding Maine not in a narrow or provincial sense, but in a sort of continental comprehensiveness, or in other words as including, in itself and its vicinity, our whole Atlantic sea-board. He has brought together twenty-three plates containing fac-similes of more than thirty maps and parts of maps on which the outlines of America as they were dimly perceived by the navigators, are definitely portrayed by the engravers; and these maps he has accompanied with elaborate and comprehensive illustrative notes and comments, to the extent of five hundred octavo pages. Among the maps transcribed are those of the Italian brothers Zeni dating from 1400, two early Icelandic maps, a part of Martin Behain's famous Nuremberg globe of 1492, de la Cosa's Spanish map of 1500, and so on through French, English, Portuguese, Spanish and Italian maps to the work of Mercator in 1569. After discussing these various charts chronologically, Dr. Kohl gives a general summary, by nations, of the parts performed by the several maritime powers in this work of discovery.

At the suggestion of Dr. Woods, M. D'Avezac of Paris, has reiterated his well known opinions on the Cabots in an appendix to the volume. The entire publication is a great honor to the State of Maine, to Dr. Woods, and to Mr. Willis who is the editor of the series.

2. *Stevens's Historical and Geographical Notes on the earliest Discoveries in America*, Art. XIX, p. 297.—The following are the contents of the maps illustrating this article:—

PLATE I.

CHART OF THE WORLD by JUAN DE LA COSA, dated 1500, the western third, reduced from M. Jormard's uncolored fac-simile. The original is in the Royal library, Madrid, on leather, colored, size 5 feet 10, by 3 feet 2 inches.

PLATE II.

No. 1. OCEANUS OCCIDENTALES SEU TERRÆ NOVÆ, reduced from the Ptolemy of 1513.

No. 2. LA CARTA UNIVERSALE DELLA TERRA FERMA and Isole delle Indie occidentali, canata da due carte da nouicare fatte in Sibilia da li piloti della Maiesta Cesarea. Venetia, 1534. Reduced to one quarter the size of the unique original in the possession of Mr. James Lenox of New York. The two pilots are no doubt Diego Columbus and Ribero whose original charts of 1527 and 1529, or contemporary copies, are preserved in the military library at Weimar, the American portions of which have been extracted and published by Dr. Kohl.

No. 3 Part of the UNIVERSALIOR COGNITI ORBIS TABULA by John Ruysch. Published in the Ptolemy of 1508.

PLATE III.

No. 1. MAP OF THE NEW HEMISPHERE by F. G. Size of the original, dedicated to Hakluyt, and issued in his edition of Peter Martyr's Eight Decades, Paris, 1587, 8vo. It is very rare. Cabot's discoveries are placed north of the Gulf of St. Lawrence and dated 1496. Virginia is here laid down for the first time, and dated 1584. Drake's landing in California is recorded under the date of 1580.

No. 2. HUNTER'S GLOBE dated 1542, three continents terminating alike in the Southern Ocean. *Paria* takes the place of *Terra de Cuba* and is separated from Zipangu by a narrow sea.

No. 3. ORONTIUS FINE'S DOUBLE-HEARTED GLOBE dated July, 1531, slightly reduced from the original in the Paris edition of the *Novus Orbis* of 1532.

No. 4. Part of the above mentioned GLOBE of ORONTIUS FINE of July, 1531, reduced to Mercator's Projection. The best authorities seem to have been used by Fine in compiling this map, but he has so misread them that his production is the culmination of absurdities. Yet the best geographers and mathematicians of his day agree with him. Schoner's *Opusculum Geographicum*, 4°, 1532, though intended as descriptions of his own new and improved globes made at Nuremberg, answers equally well for the descriptive text of this map. The names of Marco Polo in Eastern Asia, and of Cortes in Mexico, are mixed up and all laid down in one country. For this admirable reduction to Mercator's Projection the writer is indebted to his friend Mr. J. C. Brevoort, of Brooklyn, who on all occasions has liberally opened to the writer his geographical treasures to use as freely as if they were his own.

PLATE VI.

TEHUANTEPEC RAILWAY COMPANY'S Chart of the World on Mercator's Projection: showing the lines of railway with its connections of steamships and sailing vessels, with the prominent parts of the world.

3. *British Association.*—The meeting of the British Association was held at Exeter, commencing Aug. 1st; on the evening of the same day Prof. Stokes, the President of the meeting, delivered his inaugural address. The next meeting will be held at Liverpool under the Presidency of Prof. Huxley. Prof. Stokes closes his excellent address with the following paragraphs.

"But do the laws of chemical affinity, to which, as I have endeavored to infer, living beings, whether vegetable or animal, are in absolute subjection, together with those of capillary attraction,

of diffusion, and so forth, account for the formation of an organic structure, as distinguished from the elaboration of the chemical substances of which it is composed? No more, it seems to me, than the laws of motion account for the union of oxygen and hydrogen to form water, though the ponderable matter so uniting is subject to the laws of motion during the act of union just as well as before and after. In the various processes of crystallization, of precipitation, and so forth, which we witness in dead matter, I cannot see the faintest shadow of an approach to the formation of an organic structure, still less to the wonderful series of changes which are concerned in the growth and perpetuation of even the lowliest plant. Admitting to the full as highly probable, though not completely demonstrated, the applicability to living beings of the laws which have been ascertained with reference to dead matter, I feel constrained, at the same time, to admit the existence of a mysterious *something* lying beyond—a something *sui generis*, which I regard, not as balancing and suspending the ordinary physical laws, but as working with them and through them to the attainment of a designed end.

"What this *something* which we call life may be is a profound mystery. We know not how many links in the chain of secondary causation may yet remain behind; we know not how few. It would be presumptuous indeed to assume in any case that we had already reached the last link, and to charge with irreverence a fellow worker who attempted to push his investigations yet one step further back. On the other hand, if a thick darkness enshrouds all beyond, we have no right to assume it to be impossible that we should have reached even the last link of the chain; a stage where further progress is unattainable, and we can only refer the highest law at which we stopped to the fiat of an Almighty Power. To assume the contrary as a matter of necessity is, practically, to remove the First Cause of all to an infinite distance from us. The boundary, however, between what is clearly known and what is veiled in impenetrable darkness is not ordinarily thus sharply defined. Between the two there lies a misty region, in which loom the ill-discerned forms of links of the chain which are yet beyond us. But the general principle is not affected thereby. Let us fearlessly trace the dependence of link on link as far as it may be given us to trace it, but let us take heed that in thus studying second causes we forget not the First Cause, nor shut our eyes to the wonderful proofs of design which, in the study of organized beings especially, meet us at every turn. * * * * *

"When from the phenomena of life we pass on to those of mind, we enter a region still more profoundly mysterious. We can readily imagine that we *may* here be dealing with phenomena altogether transcending those of mere life, in some such way as those of life transcend, as I have endeavored to infer, those of chemistry and molecular attractions, or as the laws of chemical affinity in their turn transcend those of mere mechanics. Science can be expected to do but little to aid us here, since the instrument of

research is itself the object of investigation. It can but enlighten us as to the depth of our ignorance, and lead us to look to a higher aid for that which most nearly concerns our well-being."

4. *On the altitude of Kearsarge Mountains, in New Hampshire;* by J. R. EASTMAN, Prof. Math., U. S. Observatory, Washington. (Communicated for this Journal, Oct. 7, 1869).—Finding that the altitude of "Kearsarge" mountain in Merrimack Co., N. H., as given by various authorities, ranged from 2,000 to 3,500 feet, I made in Sept., 1868, a careful measurement of its height above the roadbed of the Northern railroad in the town of Andover.

The instruments used were a theodolite by Troughton & Simms, loaned me by Gen. H. W. Benham, U. S. Engineers, and a two-rod surveyor's chain, which was carefully tested before and after the measurements. For a base line I selected a portion of the road-bed, 2255·66 feet long, in that portion of the town known as "Andover Plain." The western end of the base was 11·55 *south* of, and in a line perpendicular to the central line of the northern rail of the main track, at a point 27·39343 from the southern terminus of the railroad in Concord, N. H. The eastern end of the base was 12·21 feet *north* of the center of the northern rail.

The angle of elevation of the highest point of the peak above the western station was found to be 4° 29′ 42″, which value coincided with the observations at the eastern station made for a check.

With these data and the horizontal angles measured at the two stations, the altitude of the highest point of the mountain above the western station was found, when corrected for height of instrument, curvature and refraction, to be 2111·22. From the railroad surveys I found that the western end of the base was 379·35 feet above the terminus of the road in Concord, and from the railroad surveys between Concord and Boston, and Concord and Portsmouth, the Concord terminus of the Northern road was found to be 236·0 feet above mean half tide.

We make, therefore, the height of the mountain 2726·57 feet above the sea level.

This mountain is an isolated peak, and has already become historic from the fact that it was the namesake of the U. S. steamer that sunk the "Alabama."

5. *Artificial Ice.*—The Louisiana Ice Manufacturing Co. at Jefferson City near New Orleans, have in operation six machines calculated to produce twelve tons each of solid ice in twenty-four hours; and with which some sixty tons a day are actually made. H. C. Millaudon, Esq., the President of the Company, announces, as we find in a New Orleans paper, under date of June 14th last, that the company had become the owner by purchase of the rights of Prof. Twining for their territory in Lousiana, and "is at present working under two combined patents of A. C. Twining of New Haven, Ct., and Armand Carré, of Paris, France." We have had occasion to allude in a previous number of this Journal to the ice machine of Prof. Twining, as being the undoubted progenitor

of all the machines operated in this manufacture in different places and countries of the world.

6. *The occurrence of Laurite and Diamonds in the native Platinum of Oregon.* (A communication from Prof. WOEHLER to Dr. C. F. Chandler, dated Göttingen, July 22d.)—In the native platinum from Oregon, for which I am indebted to you, I have found the new mineral composed of sulphid of ruthenium and sulphid of osmium, which I discovered in the Borneo platinum, and to which I gave the name of Laurite.

The crystals are very small, but by magnifying them fifty diameters it was possible to distinguish them by their peculiar luster from the dull grains of chromic iron. As it was impossible to separate the crystals of Laurite from the other minerals present, a quantity of the entire ore was subjected to chemical examination.

The platinum and gold were dissolved by aqua regia. The chromic iron was separated as much as possible by fusion with bisulphate of potassa, and subsequent treatment with dilute hydrochloric acid. The silica was expelled by treatment with hydrofluoric and sulphuric acids. The residue was then throughly washed.

On examining the material thus purified, under the microscope, it was seen to contain numerous grains of undecomposed chromic iron, beside iridosmine, and different transparent minerals, some colored, some colorless, especially minute crystals of hyacinth, which had hardly been attacked by the hydrofluoric acid.

The mixture was then placed in a glass bulb tube, and ignited in a current of hydrogen entirely free from sulphuretted hydrogen. The formation of sulphuretted hydrogen began as soon as the bulb was raised to a red heat, and continued for some time. I have elsewhere shown* that it is a peculiar property of this otherwise difficultly decomposed mineral, to give up all its sulphur on ignition in hydrogen.

The residue was then treated with hydrochloric acid to remove iron. But although hydrogen was evolved on the application of the acid, the solution contained merely a trace of iron. On adding ammonia to it, a white precipitate was obtained, which by ignition in hydrogen yielded globules of tin.

The ore thus freed from the iron and tin was then treated with aqua regia, when it yielded a brown solution, in which chlorid of ammonium precipitated a small quantity of black double chlorid of iridium and ammonium. The entire solution was then evaporated to dryness with an excess of chlorid of ammonium, and ignited in a porcelain crucible. There remained a grayish black metallic powder, which was fused in a silver crucible with hydrate of potassa and a little nitre. The fused mass dissolved in water, yielding the characteristic orange-colored solution of rutheniate of potassa, and leaving a very small quantity of oxyd of iridium. On adding nitric acid to the solution, a black precpitate of oxyd of ruthenium was produced, and, at the same time was perceived the ozone-like odor of ruthenic acid, and later, the characteristic odor of osmic acid.

* Ann. Chem. Pharm., cxxxix, 116.

In a subsequent communication, dated Göttingen, Aug. 8, Prof. Woehler continues: On examining under the microscope the mineral powder which had been freed from platinum, gold, chromic iron (in part), silica, iron, and tin, and from which the ruthenium, &c., had been removed by aqua regia, besides many grains of chromic iron and beautiful hyacinth crystals, colorless and transparent grains resembling quartz were observed, but besides these, grains resembling rounded diamond crystals were detected. To ascertain whether these crystals were really diamonds, a gram of the powder was ignited in a stream of pure oxygen gas to convert the carbon into carbonic acid. The powder was placed in a freshly ignited platinum boat, in a new porcelain tube, which had previously been ignited while oxygen was passed through it to destroy any dust that it might contain. On igniting the powder and conducting the stream of gas through baryta water, a strong cloudiness was at once produced, but the precipitate soon began to assume a brown color, and a black deposit, probably of oxyd of ruthenium, was deposited in the tube. On pouring hydrochloric acid into the tube, the precipitate was disolved with a visible evolution of gas, which, conducted into baryta water, produced a cloudiness.

I am satisfied, therefore, that besides the laurite, iridosmine, chromic iron, hyacinth, etc., the Oregon platinum contains microscopic crystals of diamonds.— *Chem. News* (Am. ed.), Nov., 1869.

7. *Minerals and a copy of Elliot's Indian Bible of* 1680, *belonging to the late Henry R. Schoolcraft, for sale.*—By letter from Mrs. Schoolcraft, just received, we learn that Mr. Schoolcraft's cabinet was valued by him previous to the war, at a thousand dollars; it is offered now for five hundred. A manuscript catalogue of the minerals accompanies them. There is a copy of Elliot's Indian Bible, which is strongly bound in calf. Besides this work, there are books and tracts in various Indian languages, to be disposed of, and also original letters, as autographs, written to Mr. Schoolcraft by prominent literary men from 1809 to 1864.

Inquiries may be addressed to Mrs. Mary H. Schoolcraft, 256 F street, (between 13th and 14th sts.) Washington, D. C.

8. *Correction.*—The biographical notice of the late Dr. Shumard in our last number, received by us from Dr. Litton and attributed to him, was not written by him. It is from the editorial colums of the "Missouri Republican."

OBITUARY.

Death of George Peabody.—This distinguished philanthropist and patron of science died in London at midnight of Nov. 4th, 1869, having recently returned from the United States suffering under severe disability, the gradual breaking up of a vigorous constitution. Mr. Peabody was born at Danvers, Massachusetts, on the 18th of February, 1795, and was at his death within three months of the completion of his 75th year. Mr. Peabody was in the strictest sense of the term the architect of his own fortunes. Com-

mencing at the early age of eleven years his commercial career, by a life of strict economy, probity and great industry, he laid the foundations of his colossal fortune, aided only by his own virtues and the remarkable intellectual ability which appeared in all his great and varied experiences as a merchant, banker and negotiator. His family, one of the oldest and most honorable in New England, descended from Francis Peabody (Paybody), who was born at Leicestershire, England, in 1614, and who came to America in 1635 and settled in the town of Topsfield, Massachusetts. Thomas Peabody, the father of the great banker, was the fourth generation from the eldest of six sons of Francis. At the early age of nineteen years Mr. Peabody was the head of a commercial firm of which Elisha Riggs was the senior and capitalist, and having removed from Washington to Baltimore in 1815 his management secured such success that branch houses were established in New York and Philadelphia. In 1829 the retirement of Mr. Riggs left Mr. Peabody the head of the house, and during several visits to Europe he conducted with entire success important negotiations for his adopted State of Maryland. For these services he steadily refused all compensation, but he could not decline the unanimous resolves of the Assembly "for his generous devotion to the interests and honor of Maryland"—conveyed to him by the Governor with an earnest assurance of the gratitude of the people. In 1837 Mr. Peabody took up his residence in London, where he continued to conduct the business of Peabody, Riggs & Co. But in 1843 dissolving his connection with that firm he established his well known banking house, designed as he said to be "an American house—a center of American news—and an agreeable place for his American friends visiting London." From this date Mr. Peabody appears as the exponent in Great Britain of American interests, sustaining the national and state finances by liberal purchases of American securities, and by his personal integrity and uprightness restoring confidence in the national faith. Thousands of Americans who visited London during the Great Exposition in 1851 will recall his timely generosity in sustaining the good name of America by discharging the costs of the arrangement of the American department left in a helpless condition by the failure of Congress to make any appropriation for its needs; and Mr. Peabody's banquets, given in singular contrast to the very simple retiracy of his private life in London, were the centers of reunion and enjoyment to all his fellow citizens who were made known to him.

When again Congress failed to make any appropriation for the Kane Expedition in search of Franklin, Mr. Henry Grinnell having furnished the vessel, Mr. Peabody placed ten thousand dollars at the disposal of the managers of the expedition, which enabled them to carry out that important search.

The first of Mr. Peabody's remarkable series of public benefactions was the gift of $20,000, in 1852, to his native town of Danvers on the occasion of the celebration of the two hundredth anniversary of its foundation, for the purpose of building a public

Library and Institute. This gift he subsequently enlarged to an endowment of $300,000.

After an absence of twenty years, in 1857 Mr. Peabody revisited the United States, an honored guest, but with characteristic modesty declining all public demonstration except one in his native town of Danvers. During this visit he laid the foundation of the noble endowment bestowed upon his adopted city of Baltimore, by the gift of $500,000, which sum he has since enlarged to $1,000,000, to furnish a free public library, and an Institute for courses of lectures, an academy of music, and gallery of art.

Returning to London in the same year he began that noble foundation for the benefit of the poor of London, which has placed him at the head of the public benefactors of Great Britain, by establishing a trust with the gift of £150,000, which he has since increased to £350,000, left without restriction except that it should be kept free from sectarian or partisan management. Already several fine squares have been covered in different parts of London with dwellings for the poor, combining features indicated in Mr. Peabody's letter of endowment. Proffers of public demonstration of regard, orders of knighthood he firmly declined, accepting only an autograph letter of thanks from the Queen of England, accompanied by a miniature portrait of herself, set in diamonds and bearing on its golden case the inscription, "Presented to George Peabody, Esq., the benefactor of the poor of London." These memorials of noble deeds are deposited in the Peabody Institute at Peabody, Mass.

In 1866 he again revisited the United States that he might with his own hand bestow still more princely gifts. During that memorable visit he gave $25,000 to the Phillips Academy, at Andover; $15,000 to the Newburyport Library; $100,000 to build a church as a monument to the memory of his mother, in Georgetown, Mass.; $16,000 to a library in the same town; $140,000 to the Academy of Science at Salem; $5,000 to the library at Thetford, Vt., where he spent a year with his grandfather when a boy; $20,000 to the Massachusetts Historical Society; $150,000 to found a Professorship and Museum of American Archæology at Cambridge; the same sum for a Museum of Natural History at Yale College; the last $500,000 of the fund already mentioned for the Peabody Institute at Baltimore; $20,000 to the Maryland Historical Society; $25,000 to the Kenyon College, Ohio; and $15,000 for a library at Georgetown, D. C.; besides the crowning donation of $1,500,000 to build up the cause of education in the Southern States of this Union, to assist schools and popular education without distinction of race or color. This endowment was increased during his last visit the past summer by an addition of one million of dollars, making a fund of $2,500,000 for this most catholic object of popular education.

During his last visit he also gave a liberal donation to Washington University in Virginia, besides distributing, it is said, $1,500,000 among the members of his own family. Mr. Peabody never mar-

ried. The aggregate of the donations bestowed in his lifetime by this most noble man is more than ten millions of dollars. Not the least remarkable or praiseworthy part of these unexampled endowments is seen in the fact that Mr. Peabody had at once the good sense and moral courage to be his own executor!

VI. MISCELLANEOUS BIBLIOGRAPHY.

1. *Twelfth Annual Report of the Board of Commissioners of the Central Park, New York, for the year ending December* 31, 1868. 8vo, pp. 164.—This beautifully printed and well illustrated document sets forth the present condition and plans of one of the most renowned of public Parks. It is a hopeful evidence of progress in the right direction, that the Commissioners recognize the growing demands made by the public for museums and collections in natural history, that these educational elements are receiving some share of attention, in connection with, and as elements of, the Park. Mr. Waterhouse Hawkins, well known for his spirited restorations of extinct animals at the Sydenham palace, near London, has been engaged during the past year or more in the same direction in the Central Park. The Appendix to this report contains a well written article on the educational department of the Park, together with the correspondence between the Comptroller, Mr. Green, and Mr. Hawkins, and the Report of the latter on the progress of the fossil restorations undertaken by him; and particularly a description of the restored skeleton of the great herbivorous saurian, *Hadrosaurus Foulkii* (Leidy), allied to the Iguanodon of the Wealdon of Sussex. The *Hadrosaurus* occurs in the Cretaceous marls of New Jersey, and the remains from which the restored skeleton are in part composed were discovered at Haddonfield, Camden Co., New Jersey, five miles from Philadelphia, in the autumn of 1858. Mr. Hawkins, after a careful and minute study of the bones of the original specimen in the collections of the Academy of Natural Sciences in Philadelphia, proceeded to model them all, and then to set up the restored original in the Halls of the Academy at his individual expense, as a contribution to the collections of their museum. The restored skeleton of *Hadrosaurus* measures 26 feet in length, and stands on its hinder extremities and tail 13 feet 3 inches high. The great disproportion between the fore and back parts of the body of *Hadrosaurus*, led Prof. Leidy to suspect that the animal ordinarily assumed a position like that of the Kangaroo, sustaining itself like a tripod, on its enormous hinder extremities and powerful tail. This position, favorable to browsing on trees which grew along the shores of the sea, upon which the animal lived, is adopted for that of the skeleton in Mr. Hawkins's restoration. From the moulds made by him in Philadelphia, Mr. Hawkins has prepared a model of the restored animal for the Central Park museum, the first of a group of animals of the former periods of the American continent, which Mr. Hawkins has undertaken to reproduce for the Central Park.

It appears from the catalogues in the Appendix, that living animals in considerable numbers have been presented to the Commissioners of Central Park, from various parts of the world, and these to a considerable extent have been preserved and are now living in the grounds. We understand also that an extensive museum has been projected and the first steps taken toward its establishment. The park will thus become a means of national entertainment and of instruction, in fact a great center of knowledge for the people.

2. *Report on the Filtration of River Waters, for the supply of Cities, as practiced in Europe, made to the Board of Water Commissioners of the City of St. Louis*, by JAMES P. KIRKWOOD, Civil Engineer. Published by permission of the Board. 178 pp. 4to. Illustrated by thirty engravings. New York, 1869. (D. Van Nostrand, publisher, 23 Murray St. London, Trübner & Co.)—Fully one half the bulk of this volume is made up by the numerous well engraved plates, most of them double, giving in plan and sections the various methods adopted in Great Britain and Continental Europe for the filtration on a great scale of the waters used for metropolitan supply. The plans adopted as the result of Mr. Kirkwood's studies, and after an inspection of the best European methods, for the city of St. Louis, are also given. This is an important subject, deeply concerning the health and welfare of all metropolitan communities, and it is nowhere of greater importance than throughout the whole internal drainage system of the United States, upon all the affluents of the Mississippi river, where the only adequate supply is by pumping water from rivers which are at all times more or less turbid and are periodically liable to floods which surcharge them with mud and slowly settling sediments.

Mr. Kirkwood's system for St. Louis embraces both subsiding or settling reservoirs, reservoirs for unfiltered water after the great bulk of foreign matter has been removed by standing for twenty-four hours in the settling reservoirs, and finally wells and conduits for the filtered water. The agents used for filtration are of the simplest description. The filter beds are formed as follows, commencing above, viz:

Fine washed sand,.....	18 inches.
Coarse sand, ...	12 "
Gravel, pea size,.....	12 "
" nut size,.....	12 "
Broken stones,.....	24 "
Drain pipe,.....	12 "
Puddle bottom.	

The rate of filtration through such a series of beds is found to be 75 imperial gallons per day for each square foot of filtering surface exposed, or half a cubic foot per hour. The size of the filter beds proposed for St. Louis has been assumed to be 260 by 156 feet, giving an area of 37,440 square feet, yielding at the rate above named 3,360,847 United States gallons in twenty-four hours. To supply 12,000,000 U. S. gallons daily required by St. Louis, five

filters of this sort are required, leaving one always out of use for cleaning the surface of the filter bed of the accumulated sediments.

Mr. Kirkwood's researches extended not only to the great works of London, York, Liverpool, Edinburgh and Dublin, but he also studied those of Hamburgh, Altona, Berlin, Tours, Angers, Nantes, Lyons, Toulouse, Marseilles, Genoa, Leghorn and Wakefield. For all these he gives detailed drawings and many statistics which are not to be found elsewhere, and he adds in an Appendix valuable data as to the 'duty' of the London pumping engines. Mr. Kirkwood's report will be highly esteemed by his engineering brethren, and must serve a most important end in convincing city councils elsewhere of the great importance and early practicability of delivering to consumers only limpid waters purged of sediments and rendered fit for human use. The work is printed in the style which has rendered Mr. Van Nostrand a favorite publisher of engineering and scientific books in the United States.

3. *Report of the Superintendent of the United States Coast Survey, showing the progress of the survey during the year* 1866. Washington: Government printing office, 1869.—The present report was made by Mr. Hilgard, assistant in charge, and contains in the Appendix a report, by Assistant C. A. Schott, of the connection of the two primary base lines in New York and Maryland by a series of 45 primary triangles. There are also three papers by Mr. Schott upon the methods in use in the Coast Survey in observavations of time, of latitude, and of azimuth. In the previous Report there was a similar treatise upon the use of the plane table, the general aim being to gradually embrace the whole range of subjects so that a collection of the articles will form a complete *Coast Survey Manual.*

In this volume are also reproduced all the articles of general scientific interest of the octavo reports previous to 1852, excepting the table of geographical positions in the report for 1851. This is reserved for a time when the cardinal longitude shall be permanently settled. This will make the quarto reports complete as to papers of scientific interest published by the Coast Survey.

4. *The progress and condition of several departments of Industrial Chemistry;* by J. Lawrence Smith, U. S. Commissioner to the Paris Universal Exposition, 1867. 146 pp. with vii plates. Washington, 1869.—The subjects selected by Dr. Smith for this Report are discussed under the following heads: Chap. I, The manufacture of sulphuric acid; Chap. II, Soda and salts of soda; Chap. III, Potash and its compounds; Chap. IV, Ammonia, baryta, magnesia and alumina; Chap. V, Chlorine, fluorine, manganese, and carbonic acid; Chap. VI, Industrial production of oxygen, hydrogen, and other elements; Chap. VII, Manufacture of illuminating gas from coal, and the utilization of the waste products; Chap. VIII. Stearic acid industry; Description of the plates. The clear and common sense manner of Dr. Smith's discussion of the topics selected by him, leaves a sense of regret that the distinguished author has not extended his researches to other depart-

ments of this extended subject so full of interest as well to scientists as to those engaged in technical pursuits. A greater degree of fullness also upon some sections of the topics discussed would have been highly acceptable and a much better reference to the text of the literature of many subjects would have given the report additional value. The very full and detailed plans for an extensive sulphuric acid works given by Dr. Smith supply a want which many technical chemists will be glad to have supplied, especially what relates to the pyrites furnaces.

The interesting chapter on Illuminating Gas gives us some important data respecting the Paris system, but leaves us hungry for more. So in the chapter on oxygen, hydrogen and other elements, it is satisfactory to know that Dr. Smith has "no doubt of the ultimate success" of Tessié du Motay's process for the industrial production of oxygen from manganate of soda; but this confession of faith is sustained by no details, and we are left without any further information accessible to most American readers, as to the practical operation of Tessié's method than come to us from the rose-colored statement of the promoters of his patent.

Technists will glean from the perusal of Dr. Smith's report numerous important hints and suggestions which cannot fail to attract attention and stimulate inquiry.

5. *Report on Excisions of the Femur for Gunshot Injury;* Circular No. 2, War Department, Surgeon General's Office, Washington, Jan. 2, 1869.—During the late war, the Surgeon General's office at Washington accumulated vast stores of statistics in the reports returned by the medical staff of the army, and amassed an unequaled museum of specimens illustrative of injuries and diseases. The office is discharging an obvious duty, and at the same time rendering a great service to medical science, in the use which it is making of this invaluable material.

"Circular No. 2" of the Surgeon General's office for the current year is one of a series of important monographs issued during several years past. It is a report on excisions at the hip for gunshot injury, by Asst. Surg. and Bvt. Lt. Col. George A. Otis, and is a complete and exhaustive study of that interesting surgical topic. Like its predecessors from the same pen, it shows the marks of unwearied labor, and of an intelligent and discriminating use of statistics which in careless or ignorant hands might prove a snare and a delusion.

This report and several other of the recent issues from the same Bureau, notably the great "Catalogue of the Army Medical Museum," are worthy of mention for the beauty of their mechanical execution; some of the best specimens of American wood engraving are to be found in their pages. F. B.

6. *Fownes's Chemistry: A Manual of Elementary Chemistry, Theoretical and Practical;* by GEORGE FOWNES, F.R.S. From the tenth revised and corrected edition, edited by George Bridges, M.D., Prof. of Chemistry in the Philad. College of Pharmacy; With 197 illustrations. 857 pp. 12mo. Philadelphia, 1869. (H. C. Lea.)—

The London edition of this popular and excellent manual, from which this American reprint is taken, was edited by H. Bence Jones and Henry Watts in 1868, who have re-written almost entirely the organic chemistry and the chapter on chemical philosophy, besides making considerable additions to all other parts of the work, and explaining the atomic weights and notation almost universal now among the chemists. Enough of the old structure remains however to give to the work a familiar look to its early friends, with many of whom it deservedly holds a high place among elementary books on chemistry. Its comparative fullness of detail and general simplicity of style render it convenient and attractive as a book of reference for both teachers and students, especially medical students; while for the purposes of a drill book in class room instruction, its very fullness is a bar to its usefulness for that purpose. In the hands of an expert teacher, however, who is master of the science, it is an admirable book, and equally so to the student who wishes faithfully to review the teachings of the chemical lecture-room.

7. *Weisbach's Mechanics: A Manual of the Mechanics of Engineering and of the Construction of Machines, with an Introduction to the Calculus*, designed as a text-book for Technical Schools and Colleges, and for the use of Engineers, Architects, etc.; by JULIUS WEISBACH, Ph.D., Oberbergrath and Professor at the Royal Mining Academy at Freiberg; member of the Imperial Academy of Sciences at St. Petersburg, etc. In three volumes. Volume First—Theoretical Mechanics, with 902 wood cuts in the text. Translated from the fourth augmented and improved German edition, by Eckley B. Coxe, A.M., Mining Engineer. 576 pp. 8vo. New York, 1870. (D. Van Nostrand).—An English translation of the first edition of this work, published in two volumes over twenty years ago, though poor as a translation, has yet been so extensively used, and, of late commanded so high a price, as to show conclusively the very great excellence of the work itself in the estimation of Teachers and Engineers. All who have known either the original or the translation named will be glad to learn that the new translation, the first half volume of which is now before us, besides being made from the fourth greatly enlarged and improved German edition, is also, as a translation, a great improvement on the old one, and, in some respects, is an improvement on the original itself, being made under the author's sanction, and embodying the latest corrections of both author and translator. This part, issued in advance of the complete volume to meet the immediate demand for it as a text book, includes the four sections: 1, Simple Motion; 2, Mechanics, or the Physical Science of motion in general; 3, Statics of Rigid Bodies; and 4, the Application of Statics to the Elasticity and Strength of bodies; together with a preliminary introduction to the Calculus. The use of the Calculus in this edition has involved the recasting of large portions of the work, as, especially, in the 4th section of this part. The entire work will, like the original, fill three octavo volumes of ten or

twelve hundred pages each. Though too extensive, perhaps, and difficult, for many besides special students and professional engineers, it will still, we hope, meet with such favor as to remunerate the enterprising publishers for undertaking to place before the country this invaluable Thesaurus of Theoretical and Applied Mechanics.

8. *On a Method of predicting by graphical construction Occultations of Stars by the Moon, and solar Eclipses, for any given place, together with more rigorous methods of reduction for the accurate Calculation of Longitude;* by FRANCIS CRANMER PENROSE, F.R.A.S. 50 pp. folio, with three plates and sets of skeleton forms. 1866. Macmillan & Co.—The title of this volume explains very well its scope. It is designed to furnish the amateur astronomer, the sailor, and the traveler with such facilities as will make the use of occultations for the determination of longitude easy and attractive.

Three charts contain scales of use in the graphical constructions, and fourteen tables are added to facilitate the reductions. Ten or fifteen minutes of labor in making the extracts, completing the computations, and working upon the chart, suffices to bring out for any given latitude and longitude, a prediction differing not more than three minutes from the truth.

9. *Smithsonian Report for* 1868.—Prof. HENRY here reviews the explorations of the continent which have been in recent progress, some of which have received assistance from the Smithsonian Institution. He dwells particularly on the efforts going forward in the country toward the collection of specimens in archeology and ethnology, and mentions also the work done under the direction or auspices of the Institution in natural science and meteorology, and for the enlargement of the National library. The list of "Smithsonian meteorological stations and observers from 1849 to 1868," which follows, occupies 34 pages. The "General Appendix" containing important papers, mostly translated from foreign journals, covers 340 pages of the Report, and gives it great scientific value. Among them are memoirs of Cuvier, Oersted, Schönbein, Encke and Eaton Hodgkinson; memoirs on the mechanical theory of heat, by J. Müller; Radiation, by Tyndall; Synthetic experiments, relative to meteorites by Daubrée; catalogue of meteorites of the Yale College collection; on the electric resonance of mountains: experiments on Aneroid barometers at the Kew Observatory; and many others.

10. *Synopsis of the extinct Batrachia, Reptilia and Aves of North America;* by EDWARD D. COPE. Transactions of the American Philosophical Society, Philadelphia, August, 1869. Part I, 4to, with 12 plates.—The author regards the Batrachia and Reptilia as distinct classes. The latter he divides into the orders: *Ichthyopterygia, Archosauria, Testudinata, Pterosauria, Lacertilia, Pythonomorpha, Ophidia.* The prominent structural features are well expressed in his synopsis. The present part includes the Batrachia, the *Ichthyopterygia*, and that portion of

Archosauria included in *Sauropterygia, Streptosauria, Thecodontia, Crocodilia, Dinosauria.* Two recent species of *Crocodilia, Perosuchus fuscus,* and *Osteolæmus tetraspes* Cope, are redescribed and figured. Mr. Cope mentions the following as the most important general results of his investigations of extinct Reptilia: 1st, that the *Dinosauria* present a graduated series of approximations to the birds, and possess some peculiarities in common with that class, standing between it and the *Crocodilia*; 2nd, that serpents exist in the Eocene formations of this country; 3rd, that the *Chelydra* type was greatly developed during the American Cretaceous, and that all the supposed marine turtles described from it, are really of the first named group; 4th, that the Reptilia of the American Triassic are of the *Belodon* type; 5th, the discovery of the characters of the order *Pythonomorpha*; 6th, the discovery of the characters of the order *Streptosauria*; 7th, the development of the characters of numerous members of the Batrachian suborder *Microsauria* in the United States.

The illustrations accompanying this memoir are profuse and well executed. V.

11. *Bulletin of the Museum of Comparative Zoology. No.* 9,—*Preliminary Report on the Echini and Star-fishes dredged in deep water between Cuba and the Florida Reefs, by L. F. de Pourtales, Assist. U. S. Coast Survey;* prepared by ALEXANDER AGASSIZ.—I, Catalogue of the Echini; II, On the young stages of Echini; III, Bathymetrical and geographical distribution; IV, List of the star-fishes.

No. 10,—*Preliminary Report on Ophiuridæ and Astrophytidæ;* prepared by THEODORE LYMAN.—I, General remarks; II, Descriptions of new genera and species, with critical remarks.

No. 11,—*List of the Crinoids obtained on the Coasts of Florida and Cuba by the United States Coast Survey Gulf Stream Expeditions, in* 1867, 1868, 1869; by L. F. de POURTALES.

No. 12,—*List of Holothuridæ from the Deep-sea dredgings of the United States Coast Survey;* by L. F. de POURTALES.—These important and interesting papers were received too late for suitable notice in this number. They contain descriptions of numerous new and remarkable genera and species, together with tables of the distribution of the species in depth and geographically. The observations of Mr. Agassiz on the structure and development of numerous young Echini are particularly important. V.

12. *The Academy, a monthly record of Literature, Learning, Science and Art.*—The first number of this new London monthly, a quarto of 28 pp., was issued by the publisher, John Murray, on the 19th of October. It promises to be a journal of fair and learned criticism, and to some extent a repository of new discoveries in its several departments. Price 6d; or stamped, 7d.

13. *Nature, a Weekly illustrated Journal of Science.* Published by Macmillan & Co., London. No, 1, November 4th. 22 pp., between 8vo and 4to, exclusive of advertisements. Price fourpence.—Devoted to discoveries in all departments of Nature-

science, as the title indicates, and advocating the views of Darwin. It includes among its contributors many of the most eminent men of science in Great Britain, and promises to be an able and spirited journal. The first number opens fittingly with the aphorisms on nature by Goethe, translated by Huxley. Then follows an article on the fertilization of winter-flowering plants, containing new results, as a sequel to Mr. Darwin's observations, by A. W. Bennett. Other subjects are—the recent eclipse of the sun, by J. Lockyer; Science-teaching in schools; the late Professor Graham; Triassic Dinosauria, (under which, Mr. Huxley gives good reason for regarding the Thecondontosaurs as true Dinosaurs, and adopts Prof. Cope's conclusions that the Bathygnathus of Prince Edward's Island is Dinosaurian); others, on a few topics in chemistry and physics, besides notices of new works, and of the Proceedings of some prominent Societies.

Allgemeine Musiklehre. Ein Hülfsbuch für Lehrer und Lernende in jedem Zweige musikalischer Unterweisung; von Adolf Bernhard Marx. 8th edition. pp. 436, 8vo. Leipzig, 1869. (Breitkopf & Härtel).

Des Tortues Fossiles conservés dans le Musée Teyler et dans quelques autres Musées; par F. C. Winckler. 152 pp., 8vo, 33 lithographic plates. Harlem, 1869.

Die Vegetationsverhältnisse von Croatien; von Dr. August Nielreich. 8vo. Wien, 1868.

Mélanges Orthoptérologiques; par Henri de Saussure. II Fascicule. 145 pp. 4to, 2 plates. Genéve et Bale, 1869.

Uber Thal- und See- Bildung. Beiträge zum Verständniss der Oberfläche der Schweiz; von Prof. L. Rütimeyer. 96 pp., 4to. Basel, 1869.

Archives du Musée Teyler. Vol. I, Fasc. 4. Harlem, 1868. Vol. II, Fasc. 1, 2, 1869.

Memoirs on the Bryozoa, by F. A. Smith. Mr. Smith, of Stockholm, has issued his important memoirs on the Bryozoa, published in the years 1864 to 1867, in an octavo volume. They are illustrated by many beautiful plates.

JOURNAL ACAD. NAT. SCI., PHILADELPHIA. Vol. VI, Part 4.—p. 303, New Unionidæ, Melanidæ, etc., chiefly of the United States; *I. Lea.*—p. 345, An Attempt to ascertain the Average Weight of the Brain in the different Races of Mankind; *J. B. Davis.*—p. 369, On Brevoortia; *A. Wood.*

PROCEEDINGS AMERICAN PHILOSOPHICAL SOC. Vol. XI, No. 81.—p. 3, Indian Sculpture; *Boyd.*—p. 4, The Maya Language; *Brinton.*—p. 15, Mylodon annectens; *E. D. Cope.*—p. 16, Cretaceous Tortoises; *E. D. Cope.*—p. 17, Philadelphia Life Tables; *P. E. Chase.*—p. 25, Notes on the Geology of Wyoming and Colorado Territories, No. 2; *F. V. Hayden.*—p. 57, The Geological Age and Equivalents of the Marshall Group; *A. Winchell.*—p. 83, Relics from Vera Cruz; *J. Marston.*—p. 85, Obituary Notice of Mr. Bancker; *Cadwalader.*—p. 91, Longitude of San Francisco; *Davidson.*—p. 92, Specimens of Silver Ore; *Dubois.*—p. 94, Periodicity of the Solar Spots; *D. Kirkwood.*—p. 103, Cosmical Relations of Light to Gravity; *P. E. Chase.*—p. 107, Boring Records in the Anthracite Basin; *P. W. Scheafer.*—p. 111, Aurora of April 15.—p. 113, Rain Curves; *P. E. Chase.*—p. 114, The Arawak Vocabulary of Shultz; *Brinton.*—p. 117, New Mosasauroid Reptile; *E. D. Cope.*—p. 118, Human Osteology; *H. Allen.*

PROCEEDINGS BOSTON SOC. NAT. HIST., Vol. XII.—p. 1, Annual Report.—p. 78, The Crocodile in Florida; *J. Wyman.*—p. 78, On a Chick with Supernumerary Legs; *E. Coues.*—p. 83, American Lepidoptera, Geometridæ; *C. S. Minot.*—p. 85, Male of Lemenitis Proserpina; *C. P. Whitney.*—p. 86, Observations on the Marsh Hare; *E. Coues.*—p. 93, Notice of a Cyclopean Pig; *E. Coues.*—p. 100, Notes on Beaver Dams; *A. Agassiz.*—p. 104, on the Habits of a few Echinoderms; *A. Agassiz.*—p. 108, On a New Species of Pedipes from Florida; *R. E. C. Stearns.*—p. 109, Molluscan Fauna of New Haven, part I, Cephalopoda and Gasteropoda; *G. H. Perkins.*

TRANSACTIONS AMERICAN ENTOMOLOGICAL SOCIETY. Vol. II, Nos. 2, 3.—p. 115, On the Synonomy, etc., of certain species of American Lepidoptera; *A. R. Grote.*—p. 122, A new Hesperian; *W. H. Edwards.*—p. 123, Catalogue of Coleoptera from South Western Virginia; *G. H. Horn.*—p. 129, New species of Coleoptera from the Pacific District of the U. S.; *G. H. Horn.*—p. 141, Synopsis of the Scolytidæ of America North of Mexico; *C. Zimmermann* and *J. L. LeConte.*—p. 179, Descriptions of American Lepidoptera, No. 4; *A. R. Grote* and *C. T. Robinson.*—p. 207, On a Remarkable variety of Papilio Turnus, and Descriptions of two species of Diurnal Lepidoptera; *W. H. Edwards.*—p. 211, Catalogue of the described Tenthredinidæ and Uroceridæ of N. A.; *E. Norton.*—p. 243, Synonymical notes on Coleoptera of the U. S., with descriptions of new species from the MSS. of the late Dr. C Zimmermann; *J. L. LeConte.*—p. 260, Descriptions of two new species of Arotes; *E. T. Cresson.*—p. 261, Notes on American Tortricidæ; *C. T. Robinson.*—p. 289, List of the N. A. species of Anthrophora, with descriptions of new species; *E. T. Cresson.*—p. 293, Notes on Cuban Hymenoptera, with descriptions of new species ; *E. T. Cresson.*—p. 299, Biological Notes on Diptera; *R. Osten Sacken.*—p. 305, New species of Orthoptera; *S. H. Scudder.*—p. 307, Structural characters of Polyommatus Tarquinius; *A. R. Grote.*—p. 308, New genus of Noctindæ allied to Dyops, with remarks on certain species of Agrotis; *A. R. Grote.*—p. 310, American Butterflies referred to the genus Charis by Doubleday; *A. R. Grote* and *C. T. Robinson.*—p. 311, Descriptions of certain species of Diurnal Lepidoptera found in the U. S.; *W. H. Edwards.*

APPENDIX. *Note by Prof.* YOUNG *to his paper*, Art. XXXVI, p. 370.—Having just received the volume of the Comptes Rendus of the French Academy of Sciences for the first half of the current year, I find that I have been anticipated by M. Faye in respect to the method of observing the contact of an opaque body with the disc of the sun by means of the spectroscope. At the session of Monday, January 11th, 1869, in a discussion upon the observation of the coming transit of Venus, he proposed essentially the same use of the spectroscope which I have described in the foregoing article.

It is unnecessary to say that until to-day I was not aware of the fact.

Hanover, Nov. 16, 1869.

INDEX TO VOLUME XLVIII.

A

Academy Nat. Sciences, Philadelphia, 298, 451.
Academy, a new monthly, 452.
Acetyl compounds of carbohydrates, *Schützenberger* and *Naudin*, 414.
Albertite, origin of, *Peckham*, 362.
Alkaloid, on a new, *Rosenstiehl*, 123.
America, notes on earliest discoveries in, *Stevens*, 299, 437.
American Association, 146.
meeting of, August, 1869, 289.
Amylene, relation of oil of turpentine to, *Bauer* and *Verson*, 416.
Andrews, E., on western boulder drift, 172.
Annulata, on recent works on, 139.
Artemia, new localities of, *Verrill*, 430.
Artesian well of Terre Haute, Ind., 270.
Atwater, W. O., on American Maize, 352.
Aureole observed in solar eclipse, 434.
Aerolites, see *Meteorites*.
Aurora at Toronto, *Kingston*, 65.
of April, 1869, *Gilman*, 114.
of April 15th, 146.
spectrum of, 404.

B

Barker, G. F., notices of papers on physiological chemistry, 49.
chemical abstracts, 123, 408.
Barnard, F. A. P., industrial machinery and scientific apparatus by, noticed, 297.
Barrande, J., Arethusina, Faune Silurienne, noticed, 138.
Beaver, remains of in N. Jersey, *Weld*, 433.
Billings, E., on Crinoidea, Cystidea and Blastoidea, 69.
Blake, J. M., on Hortonolite, 17.
Blake, W. P., report on the precious metals by, noticed, 126.
Bolton, H. C., on action of light on Uranium, 206.
Boston Soc. Nat. Hist., Proceedings of, vol. i, 452.
Brush, G. J. on Durangite, 179.
on Hortonolite, 17.
Brush, G. J., meteoric stone of Alabama, 240.
British Association, meeting of, 438.
Butterflies of N. America, by *Edwards*, noticed, 144, 433.

C

California, publications of Geological Surv. of, 133, 148, 151.
Carbohydrates, acetyl compounds of, *Schützenberger* and *Naudin*, 414.
Carbonic acid, estimation of, *Johnson*, 111.
Caton, J. D., American Cervus by, noticed, 144.
Central Park of N. York, report of Commissioners of, noticed, 445.
Chemistry, industrial departments of, by Smith, noticed, 447.
Chemistry, by G. Fownes, noticed, 448.
Chromium and iron, compounds of, *Corbin*, 346.
Clarke, F. W., on cobalt and nickel, 67.
Clouds, formation of, *Tyndall*, 268.
Coast Survey, report of Superintendent of, noticed, 447.
Cobalt and nickel, separation of, *Clarke*, 67.
Comets of 1812 and 1846, *Kirkwood*, 255.
prizes for discovery of, 279.
Corals, on, *Verrill*, 419, 431, 432.
Cope, on some reptilian remains, 278.
Synopsis of the Extinct Batrachia,
Corbin, J. H. H., on compounds of chromium and iron, 346.
Crinoidea, Paleozoic, *Meek* and *Worthen*, 23; *Billings*, 69.
Cystidean, recent, *Lovén*, 429.
Croll, J., on motion of glaciers, 273.
Crustacea of Brazil, *Smith*, 388.
new Phyllopod, *Verrill*, 244.
localities of Artemia, 430.

D

Daubrée, Substances Minérales, etc. of, noticed, 419.
synthetic experiments on meteorites, noticed, 419.

DesCloizeaux, on transparent wolfram, 137.
Descloizite of Wheatley mine, *Smith*, 137.
Delesse, Le metamorphisme des roches, noticed, 138.
Diamonds in Oregon, 441.
Diatomaceæ, spectroscopic examination of, 83.
Drift, western boulder, *Andrews*, 172.
Durangite, *G. J. Brush* on, 179.

E

Earthquake in N. England, 418.
Eastman, J. R., height of Kearsarge Mountain, 439.
Eclipse, Solar. See *Sun*.
Edwards, W. H., butterflies of N. America, by, noticed, 144, 433.
Electricity, discharge of Leyden jar with induction coil, *Rood*, 153.
Electric telegraph, manual of, by F. L. Pope, noticed, 150.
Element, new, associated with Zirconium, 405.
Entomological correspondence of Harris, noticed, 143.
Ethylates, potassic and sodic, 413.
Ethylene-sodium, new radical, *Wanklyn*, 413.
Expansion of solids, measure of, *Müller*, 407.
Exposition, Paris, Barnard's report, 297.
Blake's report, 126.
Smith's report, 447.

F

Femur, work on excisions of, for gunshot injury, noticed, 448.
Fluorhydric acid, properties of, *Gore*, 406.
Fonda, on Franklinite, 138.
Foster, J. W., Mississippi valley by, noticed, 150.
Fownes, G., Chemistry by, noticed, 448.
Frankland, on gaseous spectra, 402.

G

Gabb, W. M., Paleontology of California, noticed, 133.
Galvanic battery, *Hough*, 182.
Gas, effect of mixture with atmospheric air on illuminating power, *Silliman* and *Wurtz*, 40.
Geographical notes on earliest discoveries in America, *Stevens*, 299, 437.
Geological reconnoissance of Louisiana, *Hilgard*, 331.
survey of California, 151.
of Indiana, 138.
Geological survey of Ohio, 417.
GEOLOGY—
of Tennessee, by Safford, 416.
of Texas and Chihuahua, *Kimball*, 378.
Crinoidea, Cystidea, Blastoidea, *Billings*, 69.
Crinoidea, *Meek* and *Worthen*, 23.
Mosasauroid reptiles, *Marsh*, 392.
new fossil serpent, *Marsh*, 397.
GEOLOGY—
Paleontology of geol. surv. of Cal. noticed, 133.
Gould, B. A., statistics of Amer. Soldiers, noticed, 149.
on solar eclipse, 434.
Gibbs, Wolcott, on action of alkaline nitrites upon uric acid and its derivatives, 215.
Chemical and Physical abstracts, by, 121, 401.
Gilman, W. S., Jr., on Aurora of April, 1869, 114.
Glaciers, cause of motion of, *Croll*, 273.

H

Haidinger, W. Ritter, on Meteorites, 280.
Harris, T. W., Entomological correspondence of, noticed, 143.
Height of Kearsarge Mtn., 439.
Hercynite, *Wolle*, 350.
Hilgard, E. W., on geological reconnoissance of Louisiana, 331.
Himes, C. F., on meteors during eclipse, 435.
Hough, G. W., galvanic battery, 182.
Huggins, W., on heat of Stars, 286.
Hydrogenium, observations on, 405.
Hypononce Sarsii, *S. Lovén*, 429.

I

Ice, artificial, 440.
Illuminating power of gas mixed with atmospheric air, *Silliman* and *Wurtz*, 40.
Indiana, geological survey of, 138.
Iodhydric acid, preparation of, 411.

J

Johnson, S. W., on estimation of carbonic acid, 111.
Jones, J. M., on nat. hist. of Bermudas, Coralliaria, 143.
Jukes, J. Beete, obituary, 296.

K

Kearsarge mountains, altitude of, *Eastman*, 439.
Kimball, J. P., on geology of Texas and Chihuahua, 378.
Kingston, G. T., on Aurora at Toronto, 65.

Kirkwood, D., comets of 1812 and 1846, 255.
Kirkwood, J. P., on filtration of river waters for city supply, 446.

L

Laurite, with the platinum of Oregon, 441.
Lartet and Christy's Reliquiæ Aquitanicæ, noticed, 135.
Lea, Isaac, new species of Genus Unio, &c., by, 144.
Lesleyite, *Smith*, 254.
Lockyer, spectroscopic examination of Sun, 121, 403.
gaseous spectra, 402.
Loomis, E., on meteor of May 20, 145.
Lovén, S., on a recent Cystidean, 429.
Lutken, on Ophiuridea, noticed, 430.

M

Machinery, strength of, by *Van Buren*, noticed, 151.
Maine Hist. Soc., collection of, noticed, 437.
Maize, American, *Atwater*, 352.
Marsh, O. C., on new species of Protichnites, 46.
on fossil serpent from N. Jersey, 397.
on new Mosasauroid reptiles from N. Jersey, 392.
Mayer, A. M., notes on physics, by, 151.
report of eclipse, 436.
Mechanics, Weisbach's, noticed, 449.
Meek, F. B., on Paleozoic Crinoidea, 23.
Meteors during eclipse, *Himes*, 435.
Meteor of May 20th, 145, 146.
Meteoric stone of Alabama, *Brush*, 240.
Meteorites, experiments relative to, by A. Daubrée, 418.
light, heat, and sound accompanying fall of, *Haidinger*, 280.
Microscopic test plate of Nobert, *Woodward*, 169.
MINERALS—
Albertite, origin of, *Peckham*, 362; Diamonds, in Oregon, 441; Descloizite, *Smith*, 137; Durangite, *Brush*, 179; Franklinite, *Fonda*, 138; Hercynite, *Wotle*, 350; Hortonolite, *Brush* and *Blake*, 171; Laurite, in Oregon, 441; Lesleyite *Smith*, 254; Wellongongite, *Silliman*, 85.
Mineral resources of States and Territories, *Raymond*, 136
Minerals of Mr. Schoolcraft, for sale, 442.
Mississippi valley, J. W. Foster on, noticed, 150.
Mossman, S., origin of Seasons, by, 150.
Moon, radiation of heat from, *Rosse*, 436.
Museum of Comparative Zoology, Bulletin of, noticed, 451.

N

Nature, a new weekly, 452.
Reptilia and Aver of N. America, 451.
Nitro-prussids, formation of, 406.
Nobert, nineteen-band test plate of, 169.
North-polar expedition, Swedish, 227.

O

OBITUARY—
J. Beete Jukes, 296; Charles Grafton Page, 1; George Peabody, 441; B. F. Shumard, 294.
Ohio, geological survey of, 417.
Oxydizing mixture of nitric acid and chlorate of potassium, *Storer*, 190.
Ozone, thallous oxyd, test for, 410.

P

Page, Charles Grafton, obituary, 1.
Paleontology, vegetable, by W. C. Shimper, noticed, 272.
Paraffin, products of oxydation of, *Gill* and *Meusel*, 416.
Parkhurst, H. M., star-mapper, 163.
Peabody, George, obituary of, 442.
Peckham, S. F., on bitumens and formation of asphaltum, 131.
on origin of albertite, 362.
Penrose, method of predicting occultations, etc., by, noticed, 449.
Peters, C. H. F., discovery of new planet, 400.
Physics, notes on, by *A. M. Mayer*, 151.
Physiological Chemistry, notices of papers on, *Barker*, 49.
Pickering, E. C., solar eclipse, 425.
Planet, discovery of new, *Peters*, 400.
Platinum compounds, new series of, *Schneider*, 411.
Pope, F. L., manual of electric telegraph by, noticed, 150.
Potassio-platinic oxysulphoplatino-stannate, 412.
Pourtales, Crinoids, etc., from deep sea dredgings, noticed, 451.
Proceedings of societies, 152, 298, 451.
Protichnites, new species of, from Potsdam sandstone, *Marsh*, 46.

R

Raymond, R. W., report on mineral resources by, 136.
Reliquiæ Aquitanicæ, noticed, 135.
Reptiles, Mosasauroid of New Jersey, *Marsh*, 392.
serpent, from N. Jersey, *Marsh*, 397.

Reptilia, Batrachia, etc., of N. A., *Cope*, 451.
Reptilian remains of New Jersey, *Cope*, 278.
Rood, O. N., on discharge of Leyden jar with induction coil, 153.

S

Safford, J. M., geology of Tennessee by, noticed, 416.
Sars, Michael, memoires des Crinoids vivants, of, noticed, 142.
Schoolcraft, sale of minerals, &c., of, 440.
Scudder, S. H., entomological correspondence of Harris, 143.
Seasons, origin of, by *S. Mossman*, noticed, 150.
Serpent, fossil, from New Jersey, *Marsh*, 397.
Shimper, W. P., vegetable paleontology by, noticed, 272.
Shumard, B. F., collections of, 294.
obituary, 294, 442.
Silliman, B., illuminating power of gas mixed with atmospheric air, 40.
on Wollongongite, 85.
Sky, color of, *Tyndall*, 258.
Smith, H. L., on spectroscopic examination of diatomaceæ, 83.
Smith, J. L., on DesCloizite, 137.
on Lesleyite, 254.
industrial chemistry, by, noticed, 447.
Smith, S. I., on Crustacea of Brazil, 381.
Smithsonian report for 1868, 450.
Solar, see *Sun*.
Spectra, on the ultra violet, *Mascart*, 404.
researches on gaseous, *Frankland* and *Lockyer*, 402.
Spectrum of aurora of April, 1869, 404.
Star-mapper, *Parkhurst*, 163.
Stars, heat of, *Huggins*, 286.
Storer, F. H., on nitric acid and chlorate of potassium as an oxydizing mixture, 190.
Statistics, military and anthropological, by *B. A. Gould*, 149.
Stevens, Henry, on the earliest discoveries in America, 299, 437.
Sulphur deposit, island of Saba, 278.
Sulphur, new acid of, 408.
Sun, eclipse of Aug. 7, 1869, 286.
Gould, 434.
Mayer's report of, 436.
meteors during, *Himes*, 435.
Pickering's party, 435.
Winlock, 434.
Young, 370, 453.
physical constitution of, *Lockyer*, 402, 403.
protuberances of, *Zöllner*, 401.
Sun, spectroscopic examination of, *Lockyer*, 121.
method of viewing solar prominences without an eclipse, 401.
Sun's limb, method of observing contacts at, *Young*, 370.

T

Tennessee, geology of, by *Safford*, 416.
Thallous oxyd, test for ozone, 410.
Toluidine, new alkaloid isomeric with, 123.
Trees in Australia, 294.
Tyndall, John, on color of sky, polarization of skylight, etc., 258.
on clouds, 258.

U

Unio, new species of, by *Isaac Lea*, 144.
Uranium, action of light on, *Bolton*, 206.

V

Vanadium, *Roscoe*, 407.
Van Buren, J. D., machinery, strength of, by, 151.
on halcyonoid polyps, 419.
on localities of Artemia, 430.
Verrill, A. E., on new jelly-fish and actinians, 116.
phyllopod crustacea, 244.
on corals and polyps of West Coast of America, 432.
on polyps and corals of exploring expedition, 431.
on zoological nomenclature, 92.

W

Water, on filtration of, by *Kirkwood*, noticed, 446.
Weisbach's mechanics, noticed, 449.
Weld, M. C., remains of beaver in New Jersey, 433.
Whitney, J. D., publications of geol. surv. of California, 133, 148, 151.
Yosemite Guide Book, by, noticed, 148.
Winlock, J., on solar eclipse, 434.
Wöhler, Laurite and Diamonds in Oregon, 441.
Wolfram, transparent, *Des Cloizeaux*, 137.
Wolle, C. F., on supposed Hercynite, 350.
Wollongongite, *Silliman*, 85.
Woodward, J. J., Nobert's nineteen-band test plate, 169.
Worthen, A. H., on paleozoic Crinoidea, 23.
Wurtz, Henry, atmospheric air mixed with gas, 40.

Y

Yosemite Guide Book, 148.
Young C. A., on a new method of observing contacts at the sun's limb, etc., 370, 453.

Z

Zirconium, new element associated with, 405.
Zöllner, observations on the protuberances of the sun, 401.
Zoological nomenclature, *Verrill*, 92.
ZOOLOGY—
corals and polyps of West Coast of America, *Verrill*, 432.
ZOOLOGY—
Batrachia, Reptilia and Aves, extinct, of N. America, work by *Cope*, noticed, 451.
Crustacea of Brazil, *Smith*, 388.
Echini, Crinoids, etc., from deep sea dredgings, 451.
Halcyonoid polyps, *Verrill*, 419.
jelly-fish and actinians from Maine, *Verrill*, 116.
phyllopod crustacea, *Verrill*, 244, 430.
polyps and corals of the Ringgold explor. exped., *Verrill*, 431.
Cystidean, recent, *Lovén*, 429.

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